The Chemical Age

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Confidence Justified

IN the past weeks of acute tension in Europe, THE CHEMICAL AGE proclaimed its implicit trust in the instinctive confidence of the business community that peace would be the outcome. Last week in the darkest hour this journal reiterated in the strongest possible terms its confidence in the Prime Minister, and its conviction that he would save the world from war. There were a few fainthearts who thought this attitude altogether wrong, and insisted that the facts were an occasion for gloom rather than for hope. They even suggested that THE CHEMICAL AGE, instead of encouraging its readers to maintain their long-term enterprise without the slightest pause, should have prepared their minds for the inevitability of war.

The event has shown them to have been truly wrong, and THE CHEMICAL AGE absolutely right. Fortunately, the panic mongers, though noisy, were few. The industrial and commercial classes stood like a rock behind Mr. Chamberlain, and they have been abundantly rewarded for their trust in his statesmanship. Mr. Chamberlain, in his manly broadcast address, used these words:—"How horrible, fantastic and incredible it is that we should be digging trenches and trying on gas masks here, because of a quarrel in a far away country between people of whom we know nothing. It seems still more impossible that a quarrel which has already been settled in principle should be the subject of war."

This was exactly the view of the business classes as a whole. They based their attitude on two governing principles. First, that peace was the foremost interest of the business community as of the British people as a whole, and secondly that it was the over-riding duty of statesmanship to prevent war, unless what Mr. Chamberlain called "the great issues" were at stake, and the call to risk everything in their defence was irresistible. This broad-based steadfastness of the community on which Great Britain's prosperity and even livelihood depend was clearly an extremely important factor in bringing about the success of the Prime Minister's third and final mission to Germany.

Mr. Chamberlain was able to enter the decisive phase of the negotiations with the knowledge that he was supported by an unbroken front of steady and instructed opinion at home. Never giving up hope, taking one risk after another, and exploring every possibility that might lead him to his goal, he achieved a peaceful settlement, which, in the considered opinion of the whole world, could not have been obtained by any other living man.

So this week the world breathes again. The intolerable tension of many weeks has disappeared, and the business man finds happy release from conditions more abnormal than any he has had to face since 1918. The cost of the appalling crisis, which was weathered at the eleventh hour, cannot yet be measured. National expenditure to meet the emergency has been palpably heavy, and the bill will be presented to the tax-payer in due course. Industry and commerce must have felt some ill effects, but they suffered no major dislocation, and the structure remains intact. The stage is, in fact, set for a leap forward by British trade. Mr. Chamberlain did not rest on his oars when he averted a warlike solution of the Czechoslovak question. He signed a declaration jointly with Herr Hitler, presenting to the world the Munich Agreement and the Anglo-German Naval Agreement as symbolic of the desire of the two peoples never to go to war with one another again. The absence of such a spirit from Anglo-German relations in the last five years has been the chief contributor to the lack of confidence which retarded a revival of international trade.

Here at last is a chance of getting back to normal in business dealings. Business men on this side of the North Sea can be relied upon to do their utmost to foster the new spirit of good-will. Business may not boom for a little while, but its steadiness during the crisis has been such that there can be hope of substantial improvement in almost every department. During the coming winter politics can take second place, while the nation gives its undivided attention to work for the common good.

National Chemical Research

THERE will be found on another page a summary of what appear to be the "high lights" of the triennial report of the Director of Chemical Research which has just been issued. The 146 pages of this document contain a record of researches covering so wide a range that the task of the summariser is not to be envied. Who is to judge of the relative importance of the results secured? Who can authoritatively state whether an observation tucked away in an inconspicuous corner of this report may not turn out to be of more importance industrially than all the rest put together? Those whose duties it is to "skim the cream" from such a publication must take that chance, and approach their task with due diffidence accordingly.

The work of the National Chemical Laboratory comprises both long-range pure chemistry and the investigation of problems of more immediate practical importance. During the past three years there has been more intimate contact with industry and technical

investigations have been conducted at the request of industrial organisations. Workers have been seconded from industrial organisations and outside undertakings for work in the laboratory, a practice which appears to be capable of considerable extension with advantage to all concerned. It is very difficult for a self-contained body of scientific workers to maintain that intimate contact with practical manufacturing problems which is essential. Those engaged in industrial laboratories often find this difficulty. They also find only too often that their value to their firm is in direct proportion to their success in solving it. Sir Gilbert Morgan and his staff are to be congratulated on the close contact they maintain with industry, a contact which is inspired partly by the renown of the laboratory, partly by the visits organised with the object of bringing the work done at Teddington to the notice of industrialists, and partly by the way in which the Teddington staff takes its place on the Councils of numerous institutions.

One result of this contact is that the Laboratory acts as a feeding ground, or a post-graduate research training, to industry, no less than twenty members of the staff in various grades having resigned to take up responsible positions in chemical works. These men have presumably for the most part gone into research laboratories and will thus prove a most useful nucleus having a training in advance of that which can be expected from post-graduate university courses. It is significant that half the resignations have come from the group working on synthetic resins, a fact symptomatic of the rapid expansion of this branch of the chemical industry.

It is difficult for the chemist to peruse the report without wishing to comment extensively upon many aspects of it. It is an impressive document recording the labours of about 80 research workers and covering an astonishing range of subjects. The corrosion of metals, the many facets of high pressure research, the constitution of coal, tar, road tar, and the tar distillation industry, uses of rubber, chemotherapy, synthetic resins, water pollution and microbiology, are all the subject of extensive investigations. The mere list gives a very imperfect conception of the range of the work, and the report itself will repay the closest examination from all chemists.

Notes and Comments

The Crisis and Fine Chemicals

THE late crisis had an unfortunate effect upon many branches of business, but it appears to have created a very large demand for drugs and medicinal chemicals generally. Stocks of essential oils and medicines of vegetable origin were low and orders poured into dealers' offices in embarrassing quantities; many of the vegetable drugs are grown in Hungary and Czechoslovakia. Fortunately, the Key Industries Act has enabled us to build up a solid fine chemical industry and we were not in the same unprepared condition as in 1914. Amongst the chemicals for which an augmented demand has occurred this last month have been iodine, opium derivatives, cocaine, chloral hydrate, and indeed of most drugs in the pharmacopœia. This artificial stimulus to a key trade will have done no particular harm, but it will also have done no good except insofar as merchants have bought at home chemicals which they might otherwise have imported from abroad, because fortunately it has not proved necessary to use the goods that have been bought for emergency. It is unfortunately true that many large consignments of fine chemicals are still imported from the Continent although they could be produced here, and these few days of panic buying will surely have brought home the lesson that home production of essential chemicals must be encouraged.

Government Grants

THAT industry takes insufficient advantage of Government grants for research is the thesis of a short article by Dr. G. R. Israel in the current issue of *The Chemical Practitioner*. The D.S.I.R. makes grants up to an agreed amount pro rata with the amount that the industry concerned undertakes to subscribe, and Dr. Israel regards the fact that £50,000 a year of these potential grants remains unclaimed as a grave reflection upon industrialists. It is undeniable that many of the higher posts in industry are filled by men who are not chemically minded and who are not infrequently recruited from the purely commercial side of industry. Such men too often regard the work of the chemist as a charge only; they usually hail the successful development of a new line of goods as a triumph for the production and publicity departments—and forget the research man who may have made it possible. Failure to secure tangible returns immediately from a contribution to a research association causes the financial man to regard it as an unfortunate investment, not to be repeated. That is one side to the story. The other is that many firms may not consider the research association as the best means of spending money in research. Before agreeing that Dr. Israel's criticisms are just, it is necessary to take into account the character of the industries that have failed to claim the grants. It seems impossible, as he does, to base the complaint partly on the ground that it causes unemployment among chemists. There are circumstances in which research may be a luxury; so much depends upon the resources of the firm, and upon the calibre of the chemists; even luck may play its part.

No General Election this Year

THE business community, after emerging safely from the European crisis was momentarily faced at the beginning of the week with the possibility of a further disturbance in the shape of an early General Election. It is not necessary to enter into arguments which were strictly political as between the Government and the Opposition. If any representative section of business opinion had been consulted there would have been only one verdict—no General Election until one is constitutionally necessary. It would be a most unhappy sequel to the Prime Minister's achievement of peace abroad to have a fortnight or three weeks of discord in every constituency at home. It would mean the further retarding of confidence, which has at last some chance of reviving. Fortunately, all the indications are that the Prime Minister will not advise the King to disolve Parliament this autumn. Political tactics are being so shaped as to make it very difficult for anybody to argue that a 1938 General Election is the proper solution.

Chemistry Applied to Industrial Research

Three Years' Work at the Chemical Research Laboratory

RESEARCH undertaken at the Chemical Research Laboratory, Teddington, is reviewed in the report of the Chemistry Research Board for the triennial period ended December 31, 1937, issued by the Department of Scientific and Industrial Research. (Stationery Office 3s. net). Much of the work described in the report is of a long-term character, as for instance the researches on the corrosion and tarnishing of metals, high pressure gas reactions, the study of coal, and tar and of the rarer metals found within the British Empire. Other investigations deal with matters of more immediate industrial applicaton and are carried out at the request and mainly at the expense of industry itself. Reference is made to over 70 papers, dealing with the work, published in scientific and technical journals and to some sixteen patents covering the results of various aspects of the work including the fundamental patents covering the use of synthetic resins in water purification.

An investigation into the corrosion of metals, both in the air and in immersed conditions, has for its object the prevention of rusting, tarnishing and corrosion of metals in industrial use. A prolonged inquiry into fundamental causes is in progress with the view of throwing light on the mechanism of corrosion and of discovering measures which will lessen the immense wastage of metals by corrosion. Concurrently with this long range research, many investigations of a technical character such as the corrosion of locomotive boiler tubes and fire extinguishers, have been carried out for industry. The possibility of more widespread use of light magnesium alloys for industrial purposes adds interest to the results achieved in the protection of these alloys against attack by seawater and by leaded petrol fuels. Many efforts have been made to produce the effect rapidly by artificial means and a new method for doing this, which produces the desired coloration in the space of a few days, is described in the report.

High Pressure Research

Further experiments on the synthesis of acetic acid from methanol and carbon monoxide have confirmed the previously reported overall yield of approximately 80 per cent., and have shown that the output for the plant may be advanced to 115 grams per hour, while the conversion of methyl alcohol into acetic acid may reach 45 per cent. per passage.

The encouraging results arising out of the study of the reaction between methanol and carbon monoxide have led to a general exploration of the possibility of producing higher aliphatic acids from homologues of methyl alcohol by treatment with carbon monoxide under a pressure of 200 atmospheres and in presence of phosphoric acid. Propionic acid has been obtained in low yield from ethyl alcohol. The yield is increased as the catalyst temperature is raised from 260° C.-380° C. Unfortunately, formation of polymerides of ethylene takes place simultaneously and this process is favoured to a greater extent by increased reaction temperatures. At 150°-250° C. both *normal* and *iso*- propyl alcohol reacted readily with carbon monoxide to give a mixture of *iso*-butyric acid with higher acids. A pronounced optimum temperature for the production of acids occurred at 210° C.

In agreement with mechanism advanced in explanation of the production of acids from alcohols and carbon monoxide, experiments have shown that acids may be produced from olefins by treatment with carbon monoxide and steam under high pressure when phosphoric acid is employed as the catalyst. Ethylene leads to small amounts of propionic acid but at 290°-300° C. and under a pressure of 150 atmospheres three times as much ethylene is simultaneously converted into liquid polymerisation products. Propylene reacts readily at 200° C. to give *iso*-butyric acid, higher acids and olefinic oils. Under similar conditons 2-butylene yields a mixture of trimethylacetic, methylethylacetic and higher acids, together with the usual liquid unsaturated hydrocarbons.

In the hope that acetone might react in its enolic form and so lead to α-methylacrylic acid, experiments were carried out in which the vapour from 80 per cent. acetone was led with carbon monoxide under a pressure of 200 atmospheres through phosphoric acid. Acids were freely produced and at temperatures in the vicinity of 200° C. the acidity of the crude product reached 5-normal. In addition to acids, the product contained unchanged acetone, water and a small proportion of unsaturated neutral oils. Examination of the acids showed that the anticipated unsaturated acids were absent and that acetic and trimethylacetic acids had been produced, the former being in greater amount.

Detonation-Resisting Fuels

The production of trimethylacetic acid from acetone and carbon monoxide has been ascribed to hydrolytic fission of mesityl oxide whereby acetic acid and *iso*-butylene result. Since *iso*-butylene is a valuable source of detonation-resisting fuels, experiments have been made to determine whether *iso*-butylene or its polymerisation products could be obtained from acetone by treatment with phosphoric acid in absence of carbon monoxide. Employing nitrogen as a conveyor it was found that when acetone is passed through phosphoric acid at 200° C. either under high pressure or at substantially atmospheric pressure, the products are acetic acid and an unsaturated liquid of high hydrocarbon content which had the following distillation range :—

100°-150° C., 4 per cent.; 150°-200° C., 14 per cent.; 200°-250° C., 37 per cent.; 250°-300° C., 38 per cent.; 300° C., 7 per cent.

This liquid has been hydrogenated under pressure in presence of a nickel-diatomaceous earth catalyst, and the portion boiling up to 200° C. has been shown to have an octane number of 81.

While distilling off di-*iso*-propyl ether from an extract of organic acids, a violent explosion occurred which has been shown to be due to the presence of organic peroxides in the ether. Attention has therefore been drawn to the need for great caution in the use of this ether.

Mixtures of Higher Alcohols

In the examination of mixtures of higher alcohols produced catalytically from carbon monoxide and hydrogen, Guerbet's method of synthesis has been employed for the production of authentic specimens of certain higher alcohols. This method consists in heating together under pressure an alcohol and its sodium derivative, when, for example, propyl alcohol gives rise to β-methylpentanol. It has been claimed in the patent literature that such a coupling of alcohols can be carried out catalytically and in B.P. No. 336,811 the inventors claim to have obtained 30 per cent. of butyl alcohol by passing the vapour of ethyl alcohol under pressure over a catalyst consisting of a mixture of the oxides of copper and magnesium heated to 270°-325° C. The products also contained 14 per cent. of still higher alcohols.

Experiments were carried out in an autoclave with ethyl alcohol and a catalyst of the type indicated in the above patent, but the yield of butyl alcohol never exceeded 8 per cent. Experiments were then continued in a circulatory type of apparatus into which ethyl alcohol was introduced and conveyed by a stream of carbon monoxide or nitrogen under pressure, first through a preheater tube and then over a heated catalyst. The products of reaction contained unchanged ethyl alcohol, *n*-butyl alcohol, higher alcohols, esters and aldehydes.

With copper oxide deposited on pumice as catalyst there

was very little change in the ethyl alcohol, but addition of magnesium oxide to copper oxide had marked beneficial results. Similarly the addition of magnesium oxide to cobalt chromite had a definite activating effect. Catalysts which had proved effective in producing higher alcohols from carbon monoxide and hydrogen were tested and found to have very little action on ethyl alcohol at temperature up to 400° C. The most active catalyst tested was copper chromite (prepared by Adkin's method) to which was added an equal weight of either calcium or magnesium oxide, and a number of experiments has been made with a mixture containing the latter oxide. The gradual loss of activity of this cataylst with use has rendered it difficult to obtain really comparable results, but experiments appear to show that the yield of butyl alcohol is inversely proportional to the rate of passage of alcohol vapour over the catalyst, and for a particular rate the yield of higher alcohol increases with temperature, but the proportion of butyl alcohol diminishes. Change in concentration of alcohol vapour in the conveyor gas has little influence on the product.

Coal and Tar Researches

The action on ulmins of caustic soda in concentrations ranging from 10 to 100 per cent. has been carried out at temperatures between 100° and 250° C. The ulmins were digested for several hours at the selected temperature and the products recovered by acidification, filtration, and subsequent drying at 110° C. Ethereal extraction of the original ulmins gave a negligible result but a similar extraction of the ulmins after treatment with caustic soda yielded a deep orange-red solution which contained neutral, phenolic and acidic constituents, the last-named being the most abundant. In general the yield of this extract was low but with dry caustic soda at 250° C., 10 per cent. of the ulmins were converted to ether soluble material. The neutral portion of the ether soluble material was mainly a mixture of fusible waxes from which *n*-octacosane C_{28} H_{58}, m.p. 62° C. was isolated The acidic fraction which constitutes the major portion of the ether extract was a light brown amorphous powder readily soluble in acetone and alcohol but insoluble in benzene and light petroleum. The sodium salts dissolve in water to deep red solutions, whilst the calcium and silver salts are insoluble.

Ulmins, also known as humic acids, are present in a natural state in peat and in the less mature coals. Bituminous coals contain no natural ulmins, but can be largely converted by oxidation into alkali soluble ulmins. Such ulmins are known to function as base-exchange materials but tend to swell and disintegrate on prolonged use. Condensations have been carried out on ulmins from various sources, such as peat, lignite and oxidised coal, with formaldehyde in alkaline solution. The products exhibit an improved capacity for removing cations from solution and in addition show increased mechanical strength over the parent ulmins.

Turbulence in Chemical Operations

The high pressure plant erected for the South Metropolitan Gas Company, for the purpose of study the accelerating effect of high turbulence on chemical operations involving high pressure, has been in operation almost continuously since its completion

Experiments were carried out to investigate the possibility of hydrogenating coal in a pipe system. To obviate possible difficulties in pumping, the coal was at first treated in the form of a colloidal solution in anthracene oil. At an average reaction temperature of 460° C. and with the other operating conditions the same as for crude low temperature tar, colloidal solutions containing up to 20 per cent. coal were successfully hydrogenated to a fluid oil, about 90 per cent. of the coal being converted to oil.

In experiments carried out with low temperature tar containing tar acids it was found that, although the resins were converted to petrol soluble oils, the proportion of the product soluble in caustic soda was practically the same as that in the tar. This result indicated that very little of the tar acids had been converted to neutral oils. When, however, various fractions of the tar acids were treated by themselves in the plant, it appeared that the low boiling petrol soluble fraction could be slowly converted to neutral oil. As in the experiments with crude tar, higher boiling tar acids were readily reduced to low boiling acids with the attendant production of an appreciable quantity of neutral oil. By using the whole of the tar acids obtainable from low temperature tar and by recycling several time the product first obtained, an oil was produced consisting almost entirely of low boiling neutral oils and petrol soluble phenols.

From a representative horizontal retort high temperature tar oil distillate boiling between 280° and 360° C. and filtered from crude anthracene, there was obtained by fractionation and chilling to 0° C. a quantity of solid aromatic hydrocarbons representing almost 6 per cent. by weight of the original oil. The major portion (about 90 per cent.) of these hydrocarbons consisted chiefly of fluorene, phenanthrene, pyrene and fluoranthene, phenanthrene being the most abundant constituent. This mixture which melted between 110° and 115° C. was refractionated, whereby fluorene and phenanthrene were separated and the material distilling above 360° C. consisted chiefly of fluoranthene and pyrene.

Aqueous liquors obtained both from the gas cooling chambers and from the hydraulic main of the " Coalite " plant at Askern have been exhaustively extracted by ether in the 30-gallon extractor constructed in the laboratory. From the ethereal extract, *o*-cresol was isolated through its molecular compound with cineole, *p*-cresol by means of its compound with benzidine, and *m*-cresol by fractional sulphonation of the *p*-cresol residues, followed by desulphonation with steam. These three cresols were finally characterised as *p*-xenylcarbamates. In the extract from 80 gals. of hydraulic main liquor a total of 618 g. of catechol was obtained, together with 71 g. of resorcinol, m.p. 110° C. In the phenolic oil remaining after crystallisation of these two compounds, homo- and *iso*homo-catechols and quinol were also identified as bisphenylcarbamates.

Corrosion of Tar Stills

In March, 1934, an investigation of coal tar was started for the Association of Tar Distillers with the following objectives :—(i) To identify the compounds or groups of compounds responsible for corrosion. (ii) To devise methods for the removal of such compounds or for the inhibition of their harmful action. (iii) Alternatively, to discover a metal or alloy which would resist attack or to develop a protective coating for the mild steel in general use as constructional material for tar stills. The materials chiefly used in this research were a vertical retort tar (V.T.) of a corrosive nature and a non-corrosive coke oven tar (C.O.T.), but in addition a vertical retort tar (G.V.T.) with which no excessive corrosion had been experienced, and a typical low temperature tar (L.T.T.) were also examined, together with the aqueous liquors normally associated with V.T. and C.O.T.

After an exhaustive examination of a long series of tar fractions, the following conclusions were reached. The corrosive effect of neutral and basic constituents was negligible, but at high temperatures resinols or petroleum insoluble phenols were very active in promoting corrosion, and in the presence of ammonium chloride the activity of these materials was intensified. The more volatile phenols were not corrosive, a fact which is confirmed in industrial practice where tar acid stills have a very long life. Further examination of the whole range of resinols revealed the fact that the portion soluble in benzene was much more corrosive than the insoluble part, probably owing to the circumstance that the latter, being highly polymerised, is almost inert.

It is difficult to visualise any chemical treatment of tars which would neutralise or destroy the corrosive tendencies of resinols, but other methods which suggest themselves as possible means of counteracting such tendencies can be grouped

into the following categories :—(i) modification of the technique of tar distillation; (ii) removal of resinols before distillation; (iii) development of a surface or constructional material which will withstand the corrosive action.

Since corrosion is experienced only at higher ranges of temperatures, attempts have been made to reduce such corrosion by the employment of reduced pressures during distillation and it has been shown that when a temperature of 300° C. is not exceeded, corrosion losses are substantially reduced without any diminution in the quantity of distillate. The use of superheated steam during distillation, or pretreatment of the tar with air before distillation, had no appreciable effect in reducing corrosion losses.

The possibility of developing a technique whereby the resinoid portion of tar may be precipitated and only the oily fractions of the tar submitted to distillation has been explored. A long series of distillations in experimental stills has been carried out on the petroleum extract of a corrosive tar and it has been established that the corrosion caused by this material is much less than that manifested by a so-called non-corrosive tar under comparable conditions of distillation. In general, precipitation of tar resinoids is most rapidly effected by the use of a colloid mill, by means of which a mixture of tar with three times its volume of light petroleum is readily separated into a heavy layer of resinoids and an upper layer of tar oils dissolved in the precipitating medium.

Failing methods such as the foregoing process based on preliminary treatment of tars, a solution to the problem of corrosion of stills must be sought in the direction of finding a constructional material which will withstand the action of the corrosive constituents of tars. Efforts have therefore been made to develop a protective coating for the mild steel normally employed in the construction of stills. Slight success attended the use of a phosphatic film applied to mild steel strips, but when extended to experimental stills this film was completely destroyed after eight distillations.

In a series of tests on selected metals and alloys, the following conclusions were reached: nickel-chromium-molybdenum steels tested were moderately resistant to attack by resinols at high temperatures, whilst various stainless steels were quite unattacked by resinols alone and only slightly by resinols in presence of ammonium chloride; nickel and nickel alloys were also very resistant.

Chlorinated Rubber

The different types of products which can be made with chlorinated rubber, that is rubber which has been treated with chlorine either in the form of a gas or liquid, have received attention. Sheets of linen were impregnated with a solution of chlorinated rubber in benzene or carbon tetrachloride and the solvent removed when the sheets were submitted to pressure at 140° C. If the materials were allowed to cool under pressure hard, dense, boards were obtained, but if the pressure was released when the ingredients were hot, very light laminated materials of a cell-like construction resulted. Chlorinated rubber can be used with various fillers, such as asbestos, woodmeal, etc., as a moulding material giving products of considerable strength. The most striking of these properties, the report states, is that it can be utilised as a plastic without the addition of any filler. When compacted under pressure of one ton per sq. in. at 115° C. to 120° C. for a short period, an opaque moulding is produced when the pressure is released at this temperature. If, however, the pressure is retained while the mould is cooled to about 70° C. then a completely transparent moulding is obtained.

Chlorinated rubber unites with basic colouring matters in a remarkable manner. When the carbinol base of rosaniline or of brilliant green is dissolved in the benzene solution of chlorinated rubber, the colour of the dye is rapidly developed. On evaporation of the solvent, coloured films remain from which the dye is not readily extracted by water, dilute acids or alkalis. Such coloured material could be utilised in the production of transparent moulded articles.

The work undertaken on synthetic resins is divisible broadly into two main classes, namely examination of resins from phenolic and from ketonic sources. In each case, long range investigations of a fundamental nature, such as that on the structure of phenolic resins, have been carried on in conjunction with efforts to develop more immediate applications of the material studied, as for example in the work on catechin and related substances, and on the utilisation of resins for adsorption of ions from aqueous solution.

Synthetic Resins

In view of the objectionable nature of *o*-cresol, which has an alkaline resinfication time between those of *m*-cresol and phenol, and which forms condensation products having little tendency to heat-harden, more detailed attention has been given to this phenol. Condensations were carried out with constant amounts of *o*-cresol and catalyst, and varying quantities of formaldehyde. The washed condensation products were distilled *in vacuo*, whereby unchanged cresol and simple condensation products (which formed the major part of the resin) were removed. The yields of these products, dihydroxyditolylmethanes, bore little relation to and varied little with alteration in formaldehyde content, and it was concluded that resinification times must be regarded as depending mainly on the previously suspected solubility effects.

For following the course of phenolic condensations, a method depending upon observations of "turbidity temperatures" has been devised. Mixtures of *m*-cresol and formalin, with or without added catalyst, are heated at 100° C., or other constant temperature, for given periods of time, and the temperature at which turbidity sets in is then observed. By plotting these "turbidity temperatures" against time, a curve is obtained which shows certain inflections, corresponding presumably to definite stages of condensation. Attempts were made to identify compounds produced at these points of inflection by distillation of the products, with the result that a method was indicated, involving both distillation and pyrolysis, whereby information was obtained as to the actual structure of phenolic resins.

Resins were prepared by condensing phenols with formaldehyde up to turbidity point at 100° C. They were washed with hot water until neutral and then distilled *in vacuo;* whereby unchanged phenol, and condensation products consisting almost entirely of dihydroxydiarylmethanes, were removed. The residue was subject to pyrolysis at about 450° C. under normal pressures and yielded an aqueous distillate. The latter, on extraction with caustic soda, yielded a mixture of phenols containing the original phenol with certain of its *ortho* and *para* methyl homologues.

Resins for Water Treatment

It has been found that insoluble condensation products of formaldehyde with certain phenolic substances possess the property of adsorbing cations from solution (B.P. 450,308/9). The mechanism of cation removal resembles that of the base-exchange materials, and in fact the polyphenolic products can be employed for softening hard water, by removal of calcium and substitution of sodium. The processes of water treatment are described in detail in the Report of the Water Pollution Section (p. 93).

The desirable properties for a product used in water treatment may be summarised in cheapness, insolubility and high mechanical strength, so that the granules do not readily disintegrate. These requirements are most readily met in condensation products prepared from polyhydric phenols, which can yield with formaldehyde, hard, infusible, insoluble and brittle products. Cheapness is achieved by the employment of natural polyhydric phenols, of which various tannins, for example, catechin and quebracho tannins, gambier and larch bark extract, are representative. When cheapness is not the first essential, products made from resorcinol,

phloroglucinol and other pure phenols may be used. It has been shown also that products from mixtures of phenols, including a monohydric phenol as one constituent, for example *m*-cresol with quebracho tannin, posses higher adsorptive powers than would be anticipated from either of the ingredients separately.

The general method of preparation consisted in adding not less than two molecular proportions of formaldehyde, together with concentrated hydrochloric acid, to a boiling solution of the phenol in water or in alcohol-water. The powder or gel produced was dried, ground and graded, and after washing with alkali, acid and water, was ready for adsorbing metallic ions. Considerable improvement was achieved by " sulphiting " before condensation, a process which consisted in heating the phenol or tannin with aqueous sodium sulphate for some hours.

Condensation products prepared from certain aromatic bases, of which *m*-phenylenediamine was the best, have been shown to posses the property of removing or exchanging anions such as sulphate and chloride, from solution.

Recovery of Rare Metals

Successful attempts have been made to extract some of the rarer metals known to exist in coal or coal ash, and which are also found in the flue dusts that accumulate in the producer gas mains and waste gas flues of gas works. Gallium, germanium and other metals were recognised and recovered in varying but mostly very small amounts, whilst a small quantity of rhenium was extracted from some Australian molybdenite.

As molybdenites often contain small quantities of rhenium an examination was made of Australian molybdenite in this connection. Two lots of ore were worked up, each batch being heated with nitric acid and much of the molybdenum removed as trioxide. A further separation was obtained by precipitating ammonium phosphomolybdate. This method is not very satisfactory, the reaction being far from quantitative on a large scale and, in dealing with the second batch, it was omitted. Instead, the molybdenum and rhenium were precipitated as sulphides, treated again with nitric acid and a further removal of molybdenum trioxide effected. In both cases the metals were converted through the sulphides to the oxides and these distilled from concentrated sulphuric acid in a current of hydrogen chloride. Under such conditions rhenium is appreciably more volatile than molybdenum and it is enriched in the distillate.

Final separation of the metals was carried out in one of two ways. According to the first method molybdenum was removed by means of 8-hydroxyquinoline, while the residual rhenium was precipitated as nitron perrhenate. In the second case advantage was taken of the fact that dipyridyl molybdate is almost insoluble in the presence of excess 2 :2'-dipyridyl, whereas dipyridyl perrhenate is reasonably soluble. The yield of rhenium obtained was 46 mgs. which corresponds to a proportion of about 0.00011 per cent.

Flue Dust Examination

By the courtesy of various gas companies the Chemical Research Laboratory has been enabled to examine a considerable number of flue dusts, both those found in the producer gas or carbon monoxide mains and those from the waste gas or carbon dioxide flues. As was anticipated, the material from the producer side is usually poorer than that deposited on the waste gas side, for the former dusts may contain up to 60 per cent. of carbonaceous matter which is subsequently removed during combustion. One notable exception to the rule was found in the samples obtained from the South Metropolitan Gas Co., where the dusts from the carbon monoxide main were considerably richer (0.5-0.8 per cent.) than those from the waste heat boiler flues (0.3 per cent.). In this installation the producer gas is roughly filtered to remove the larger particles of coke entrained in the gas and so effects a certain concentration of germanium and gallium which are not retained to any appreciable extent by the filter.

During the last three years considerable progress has been made with researches on ruthenium derivatives, with particular application to the valency and co-ordination of the element, and this work has been greatly facilitated by a loan of metallic ruthenium from the Mond Nickel Co. Ruthenium, one of the rarer of the six platinum metals, readily yields ruthenium trichloride when heated with chlorine containing a small proportion of carbon monoxide.

Rothamsted Experimental Station

Rapid Methods of Soil Analysis

THE 1937 report of the Rothamstead Experimental Station, Harpenden, has just been published. A full account of the laboratory work is given, supplemented by abstracts of recent papers.

In the chemical department the numerous field experiments have provided material for the study of analytical methods of estimating the manurial requirements of soils, and particular attention is being devoted to rapid methods of soil analysis. Perhaps one of the most interesting aspects of the biological work is the study of strains of the nodule organisms of leguminous plants; some of these strains instead of being beneficial have been shown to be actually parasitic and, in addition, they are so aggressive that they can displace many of the strains that show the usual beneficial action on the plant. Fortunately certain strains have been discovered that are both beneficial and also capable of competing with the worthless strains. The report contains a summary of twenty years' work in the department of plant pathology, in which the contributions relating to the study of wart disease of potatoes, take-all disease of wheat, and the group of virus diseases are set out with full references. The report can be obtained from the Secretary, Rothampstead Experimental Station, price 2s. 6d.

Institute of Fuel

Annual Meeting

THE annual meeting of the Institute of Fuel will be held in London on October 13. At 2.30 p.m., in the meeting hall of the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, the incoming president, Lt.-Col. J. H. M. Greenly, will be installed as president for the coming year by Sir Philip Dawson, M.P. The installation will be followed by Colonel Greenly giving a short presidential address.

At 3.0 p.m. (not 3.30 p.m. as previously notified) the Melchett medallist for 1938, Professor Richard Vernon Wheeler, D.Sc., F.I.C., will give his Melchett lecture entitled " Destructive Distillation."

The annual dinner will be held at the Connaught Rooms, Great Queen Street, Kingsway, W.C., when the President, Lt.-Col. J. H. M. Greenly, will preside. The President and Mrs. Greenly will receive the members and guests at 6.45 p.m. and dinner will be served at 7.15 p.m. The guest of honour will be Professor Sir William Bragg, F.R.S., who will propose the toast of "' The Fuel Industries," to which the president will reply. The president will then propose the toast of the Melchett medallist, and present the Melchett medal for 1938 to Professor Richard Vernon Wheeler, D.Sc., F.I.C. The only other toast will be that of " The Visitors," the response to which will be given by Captain H. F. C. Crookshank, M.P., Secretary for Mines.

The dinner will, as usual, be followed by a dance and cabaret performance, which will be given in the banqueting hall about 11 p.m.

Applications for tickets (22s. 6d., exclusive of wines) should be made to the Secretary, Institute of Fuel, 53 Victoria Street, London, S.W.1.

Training Scientists for Industry*

By

DR. E. A. RUDGE, F.I.C., A.M.I.Chem.E.

(Head of Science Department, West Ham Municipal College)

IF you are in the habit of reading the technical papers you have noticed that during the past few years a great deal of attention has been paid to the subject of training, especially for the chemical industry and chemical engineering. It is very obvious that both industry and the teaching profession feel that the present system is inadequate. Unfortunately, most of the meetings, lectures, and symposia on the matter have expressed more or less private opinions, unsupported by data. This is probably because data are difficult to obtain. Moreover, if you study the reports of these opinions carefully, you will find that they represent a minority of interests, usually the big employer of scientific workers.

The Need for Specialists

It was the need of the big chemical organisations for highly-trained specialists which led to the development of the chemical engineering course of study. But this comparatively new scheme of training only touches the fringe of the problem. At present, and probably for many years to come, chemical engineers will rarely be found on industrial staff organisations. Few industries find the need for them. There is, on the other hand, an increasing demand for trained scientists of other types, employed in twos and threes by a multitude of smaller laboratory organisations. This demand does not appear to be met by any existing method of training. The attention which has been given to chemical engineering is very much out of proportion to the numbers recruited into the personnel of industry, and I am of the opinion that industrialists should as insistently call attention to the need for a complete overhaul of our system of scientific education. The object of nearly all academic courses of study is a degree, and whereas at one time the graduate standard adequately satisfied the demands of industry, it is now commonly found that the degree is by no means rated at a high industrial value. The reason for this lies in the recent history of scientific development, and in order to appreciate it, let us inquire into the scientific requirements or industry in some detail.

The scope of scientific control in industry has increased to a phenomenal extent during the last twenty years. Not only in the newer, highly technical light industries, such as plastics, viscose, drugs, etc., do we find the widespread applications of specialised academic knowledge, but also in the older industries, such as heavy chemicals, metals, and mining, are now to be found a surprising number of methods and applications which not so long ago only existed in the laboratories of our colleges. It is difficult for the youthful student of science to comprehend the revolutionary character of these changes, but to older members of the professions it becomes one of the most striking developments of post-war industry.

For the moment I am not referring to those scientific methods of control which may be called gadgets. These in general do not call for a correspondingly highly-developed scientific knowledge for their operation. I may quote such items as colorimetry, spectroscopic analysis, X-Ray examination, and electrometric *p*H determination. I do not think it is generally appreciated that much of the credit for the rapid and widespread adoption of these aids to routine control is due to scientific instrument makers, who have marketed a type of instrument which often reduces manipulation to the level of knob-twiddling.

I refer more particularly to the industrial applications of recent academic research discoveries, which are possibly no more extensively marked than in the plastics industry. These industries may be considered to be the applied expression of two natural processes—polymerisation and catalysis—and call for a wide knowledge and high standard of organic chemical technique. In addition, the use of plastic materials in electrical engineering, in paints and lacquers, and, more recently, in optical practice, demand a very considerable knowledge of many sciences.

Closely linked with these applications of pure science is the enormous increase in the amount of routine testing work, due to the setting of detailed standard specifications. Although this work calls for no originality of thought, and consists of usually simple manipulation according to defined instructions, it requires speed and accuracy—qualities which are not necessarily developed by academic training. The value of this work is not rated very high, as a rule, and remuneration is very variable, ranging from 15s. a week to £3 a week. It is clear, therefore, that industry finds employment for a varied army of scientific workers, ranging from routine semi-skilled testers to fully-trained research specialists. If we attempt to analyse the distribution of scientific employment into academic grades in the way suggested by these considerations a difficulty is at once met with, in that each and every industry has its own special requirements. To make matters even worse, each and every firm has its own ideas about the type of recruit most suitable for its special interests.

No difficulty is found in obtaining supplies of the low-grade semi-skilled type, and I should like to add that many employers testify to the excellent material frequently produced by the secondary school and central school. Unfortunately this employment is often unprogressive, and often little more than blind-alley occupation.

The Greatest Problem

At the other end of the scale we have the highly-trained research specialist. His scope in industry is largely restricted to the big organisations or grouped industrial research associations, and his remuneration is high. This type of worker is recruited from among the numerous post-graduate students of the universities, and, the demand being much smaller than the supply, industry is able to skim off the cream from the annual flow of graduates and post-graduate students. But it is the other group of industrial scientific workers, intermediate between these two, which sets the greatest problem. Originally recruited from the graduate class of student, in recent years there has been a growing tendency to take them from other sources. Employers are constantly searching for suitable material and it is the difficulty experienced in finding suitable sources of the right type which give rise to most of the criticism so frequently voiced against our educational system.

These conclusions are not entirely a matter of personal opinion. They are supported by the results of an inquiry recently made, in an attempt to arrive at a representative conclusion regarding the distribution of scientific employment. It was necessary to limit the inquiry to chemical workers in the first case, and to a defined area in the other. The area chosen was West Ham and the neighbourhood, which forms one of the most varied and heavily-industrialised districts in the country. A carefully prepared questionnaire was sent to over 300 firms considered to be potential employers of chemical workers. About 50 per cent. replied, and the results were analysed.

The most outstanding observation made was that about one-third of these firms employ no scientific staff of any type. Many are concerned with distribution of chemical products, or in the processing of materials of such a character that the

* Paper read before members of the Chemical Club, West Ham Municipal College, Stratford, E.15.

expense of technical control and the installation of laboratories is not justified. Of the remainder, an analysis of laboratory personnel showed the following distribution :—

TABLE 1.

		%		Representative % employed.
Small	With one or two persons ..	20	30	3
,,	,, from 2 to 4 persons ..	20	140	15
,,	,, ,, 5 to 9 ,, ..	30	225	25
Large	,, ,, 10 to 20 ,, ..	15	225	25
,,	more than 20 ,, ..	15	300	32
			920	

Thus, in the area under examination, 70 per cent. constitute what may be termed small laboratory organisations.

The second question inquired into the grading of these employees into academic standard at the time of appointment. The replies revealed the following :—

TABLE 2.

Age under 16	10%
Age over 16	43%
With Matriculation	13%
With Intermediate B.Sc.	7%
With B.Sc.	21%
With M.Sc., Ph.D., etc.	6%

That is, one-half were recruited as unqualified juniors, or, alternatively, almost three-fourths if we include undergraduates. Note also the relatively small number of recruits with research degrees and experience. Coupling the information summarised in these two tables, it further appeared that the majority of graduates and post-graduate recruits were employed by firms with the largest technical organisations. Laboratories with a total personnel of ten or less commonly employed unqualified recruits.

TABLE 3.

Distribution of Qualified Recruits.

Total personnel of firms	% of total graduates recruited.	% of total post-graduates recruited.
Small 1 or 2 persons ..	2	nil
,, 2 to 4 ,, ..	14	8
,, 5 to 9 ,, ..	23	25
Large 10 to 20 ,, ..	14	42
,, 20 ,, ..	47	25

The percentage of these unqualified assistants engaged in degree course studies in evening classes is very high. In practically every case such studies are encouraged, and indeed, occasionally made a condition of employment.

The Market for the Graduate

Many instances are met with in which the posts of highest responsibility are held by these men originally recruited as juniors, and now qualified partly by academic studies, but more especially by valuable experience with their firms. In most industries junior recruits are given opportunities to develop those qualities leading to laboratory and process control. This is an important factor further restricting the market for the graduate recruit.

Very valuable data were adduced in reply to a question regarding the type of training likely to provide the most suitable source of recruits for the future requirements of the particular employer or industry. The frequent and recent pronouncements on the question of training have emphasised the opinion of industry that the present system does not produce a really useful type of recruit, either in the graduate or undergraduate stage, and for this reason, categories were scheduled including some with a training in industrial method, as follows :—

TABLE 4.

	%
(*a*) Boys of elementary education with some knowledge of chemistry	16
(*b*) Matriculated students with a year's training in industrial method	42
(*c*) Intermediate B.Sc. students with a year's training in industrial method	27
(*d*) Graduates with experience in academic research	9
(*e*) Graduates with a knowledge of chemical engineering ..	6

In the replies an overwhelming preference is shown for unqualified assistants of about matriculation standard with a knowledge of industrial method and technique. Employers are about equally divided on the opinion that the present sources of supply are satisfactory or not, but there is a great weight of evidence that the present systems of training are incomplete.

Two points of great interest may be noticed by comparing tables 2 and 4. The first is that whereas in the past 53 per cent. were recruited below matriculation standard, and only 13 per cent. at this level, the present tendency is to set the matriculation as the lowest academic standard for future employment. This is confirmed in many instances by correspondence from certain of the firms contributing to the questionnaire, and is clear evidence that industry is making an effort to raise the standard of general education of its junior employees. The second point is that the popularity of the graduate has fallen considerably, and the figures in the tables form a statistical confirmation of the important fact already mentioned that the scope of the graduate in industry is becoming more and more restricted. The introduction of chemical engineering as an alternative to research does not sensibly ease the situation.

Laboratory Routine Workers

Emphasis must be laid upon the fact indicated above that for every graduate required for the specialised work of research development, more than nine undergraduates are required for laboratory routine. The demand for the more responsible posts of process control is proportionately even less. This greatly increased demand for laboratory routine workers is a most important recent development, and one which deserves the closest attention. The routine work undertaken is that which was previously carried out by graduates, but the rapid extension of technical control, with its wider demand for more and more assistants has induced the employer to supplement his staff with cheaper and less qualified types of recruits. It must be conceded that this method has been justified by its success. After a period of training these juniors are able to fulfil their duties with satisfaction, but it is the period of training which gives rise to many of the criticisms of industry concerning our methods of teaching. I am repeatedly being told by employers of the almost total ignorance among these juniors of the most elementary industrial practice, and of the urgent need of some form of vocational training to render them more readily adaptable to works conditions.

My experience has been that industry welcomes any step to alleviate the situation. In September of last year, the West Ham College offered a course of part-time day practical work in the methods of industrial analysis, to be held on Monday afternoons throughout the session. Within a week 16 boys of about matriculation standard were enrolled, their fees and wages paid by the employers. Reports show that this work is fully appreciated, and the efficiency of the juniors greatly increased.

The analysis I have put before you admittedly describes merely the East London area only, but it may be claimed to represent, I think with confidence, the whole of our chemical industry. Twenty years close observation of conditions in other industrial areas supports the general view I have outlined, although in these cases statistics are not available.

I propose now to turn to the academic aspect of the problem. Whilst industry has been developing a demand in a downwards academic scale, the tendency of the colleges has been to produce an increasing proportion of trainees of a higher academic level, and this has led to a drawing apart of interests. Thus we have the repeated complaints of industrialists of a scarcity of suitable recruits on the one hand, and of the dissatisfaction of teachers with the usually low industrial status of graduates on the other.

Routine analysts are needed in great numbers, and a graduate is no more suitable for this type of occupation than

an undergraduate. There is a growing body of opinion that in the teaching of pure science, insufficient attention is paid to its applications, and further, that the teaching is frequently in the hands of those with an all-too-scanty knowledge of industrial conditions. This was voiced by Dr. Cullen, in his presidential address to the Institution of Chemical Engineers on February 18, 1938, who said, "I am one of those heretics who believe that the men who teach applied science should have some practical knowledge of its applications," and again "one sometimes wonders whether, so far as the teaching of chemistry is concerned, the right men are in the key positions."

Industrial Experience

Viewing this very serious criticism from the inside, as I do, it must be confessed that frequently it is only too true. Large numbers of our younger teachers, especially in technical colleges, are recruited from among the more academically brilliant University graduates. These men are usually made responsible for the training of junior and vocational classes, a circumstance least likely to produce the right type of industrial recruit. Unfortunately it does not seem possible to attract men with a successful industrial record to the teaching profession, for as a whole, the latter is not sufficiently progessive or remunerative. Most advertisements for teaching posts nowadays contain the sentence "should have industrial experience," but, as a rule, one finds that the industrial applicants are unsatisfactory for one reason or another. I think, however, that Dr. Cullen's criticism would very largely be met, if closer co-operation could be arranged between industry and our college staffs.

Perhaps the day may come when education authorities will see the wisdom of releasing teachers in key positions for occasional short terms in industrial laboratories. In the meantime, teachers could do much to improve the situation by taking a greater interest in industrial matters. Very few belong to the technical societies and associations. Except for an occasional "works visit" they do not make acquaintance with the insides of industrial laboratories. I know that in many cases there are reasons for this; a teacher's time is very fully occupied for such extra activities; but I do feel that most of our present problems of training arise from this point. I am not sure whether a move in the direction of co-operation should come from the teachers or from industry, but I am certain, from my own experience, that industry would welcome such a step.

Perhaps I may make a suggestion here. It is, that the various technical and industrial associations invite the scientific staffs of the colleges to visit and inspect the administration of industrial laboratories in their localities. Eventually, I should like to see conferences held, representative of both interests, for the purpose of thrashing out the whole problem. I am aware that this method has been tried in the past, but not in a general way, and certainly not in regard to the special problem outlined in these notes.

Undergraduate Trainees

Now let us consider, in view of the undoubted demand for suitable trainees of an undergraduate type, how we may modify our teaching methods, by introducing vocational scientific training at an early academic stage. In this connection I should like to describe the scheme now in operation at the West Ham Municipal College. Through the co-operation of the education authority, the secondary schools of the borough were interested, and a selected group of matriculated students was transferred to the Municipal College. Selection was based upon general suitability for practical science, and upon inclination for industrial work. These students are undertaking a one-year course in industrial science including the following subjects:—General methods of industrial analysis, industrial physics, elementary fuel technology, the generation of power, business economics including principles of costing, and engineering drawing. In addition the study of pure and applied mathematics and of pure chemistry, up to Intermediate B.Sc. standard are continued. The course will be largely practical in character.

The methods of industrial analysis will include such physical methods as sohxlet extraction, viscosity determinations, etc.; gasometric, colorimetric, and nephelometric methods; and certain gravimetric methods commonly used in works laboratories, but rarely met with in academic practice, particularly at this stage. Industrial physics will include measurement of pressure and temperature, and the use of optical apparatus including the microscope and camera. In fuel technology the students will carry out the more usual determinations on solid and liquid fuels, and will undertake a course of gas analysis. Local industry is giving valuable help to the scheme by supplying detailed schedules of current analytical methods and specification tests.

The importance of speed and dependability in practical work will be emphasised, and it is anticipated that the trainees will eventually develop a strong industrial outlook. I am confidently led to believe that these students will readily be absorbed in progressive posts in industry, where their further academic education to graduate standard will be sympathetically encouraged. This scheme has the approval and support of the West Ham education authorities. It will co-ordinate the educational service of the borough in so far as science is concerned. Moreover, it makes a serious attempt to win the confidence of industry by supplying adequately trained recruits for the group of laboratory assistants and junior chemists which forms the backbone of very works organisation.

Silicon Carbide

Extended Uses as a Refractory

SILICON carbide is now being more widely used as a refractory material in the form of cements, crucibles, retorts, etc., especially on the continent. Combustion chambers constructed of such refractory materials are proving of great advantage where rapid heat liberation is desired and where there must also be freedom from soot or smoke coming into contact with the material which is being heated. Oil stills, ceramic kilns, heat-treating and annealing furnaces are typical examples of application.

There is also a growing tendency towards the operation of boilers with a high rate of fuel combustion, and in place of furnaces in which from 15,000 to 20,000 B.Th.U. per cubic foot per hour were liberated beneath the boiler, installations are now of the order of 35,000 to 50,000 B.Th.U. per cubic foot per hour. In the old type of boiler the fireclay brickwork forming the heating chamber is quick to burn out at these newer rates of fuel consumption, since the fused coal ash readily reacts with the brick at the higher temperatures and so destroys the furnace setting. Overheating difficulties have been avoided by cooling the walls with air or water, and it is in the construction of these cooled walls that silicon carbide has been found to be a serviceable material. The high heat conductivity of the silicon carbide allows heat to be withdrawn from the inner surface to the cooling medium at a rate sufficiently rapid to chill the exposed face of the furnace brickwork, thus causing the temperature to fall below that at which the brick reacts with the fused coal ash. In consequence a layer of congealed ash is formed adjacent to the refractory.

Silicon carbide has also been used somewhat extensively for intermittent types of oil burners in the form of ignition baffles against which the oil is sprayed. Its highly refractory nature and ability to conduct electricity has also led to its use as a material for making electrically-operated heating elements, temperatures as high as 1,500° C. being attained. Such non-metallic resistors are being used in furnaces for heat-treating and forging, where temperature ranges are beyond the possibility of the metals ordinarily employed.

New Technical Books

THORPE'S DICTIONARY OF APPLIED CHEMISTRY. By Jocelyn Field Thorpe and M. A. Whiteley, assisted by eminent contributors. Vol. II, 4th Edition. Pp. 711. London: Longmans, Green and Co. 63s.

Valuable criticisms were made by reviewers and others in the manner of treatment of Vol I of the new edition of Thorpe's Dictionary, and these, as far as possible, have been incorporated in Vol. II. The method, mentioned in the preface to Vol. I, by which later volumes are used as a means of bringing the subject matter of earlier volumes up to date appears to have worked well. This system, however, can only be applied when the index letters of the main articles and those of the sub-sections are remote and diminishes in value as these index letters approach one another. Many fresh monographs have been prepared by authors who are expert in their subject, although the "dictionary" style has been maintained throughout. The present volume ends with "Chemical Analysis," so that the subject matter of Vol. I and II of the new edition covers Vol. I and II, to the inorganic section. It is now pointed aim of the editors in the present volume has been the same as that in Vol. I, namely, to give the reader a concise and readable account of the condition of modern chemistry written in a form which can be understood not only by the expert but also by the reader with a general knowledge of chemistry. One or two reviewers of Vol. I suggested that too much space had been given to organic chemistry. This, however, was more apparent than real, for if the pages allotted to each of the chief branches of chemistry were numbered, it would have been found that, counting only the reading matter, more space has been allotted, in both Vol. I and II, to the inorganic section. It is not pointed out that it is the space occupied by organic formulae which makes these articles so bulky and thus given them the appearance of predominance. The authors hold the view that articles in a dictionary of this kind must be clearly and concisely written, and no modern article on a subject in organic chemistry can be constructed to comply with these conditions unless it is illustrated by elaborate formulae. In the matter of illustrations of technical plant, the reproduction of illustrations from the advertisement pages of the chemical and chemical engineering press has been avoided, as much apparatus illustrated in this way deals with appliances made for a specific purpose, and the object of the Dictionary to be as general as possible. Such illustrations have been used only when they are specific to the article in question; in most cases special drawings have been provided.

INORGANIC COLLOID CHEMISTRY. By H. B. Weiser. Vol. III The Colloidal Salts. Pp. 473. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 30s.

This book is the last in a three-volume treatise on inorganic colloid chemistry which deals with the colloidal behaviour of the elements and their inorganic compounds. Like the two preceding books, "The Colloidal Elements" (1933) and "The Hydrous Oxides and Hydroxides" (1935), this volume, entitled "The Colloidal Salts," is concerned primarily with the contributions that have been made to the theories and applications of colloid science from observations on inorganic substances. The importance of the salts in the study of colloidal phenomena is evidenced by the amount and character of the work that has been carried on with this class of compounds during the past decade. So significant are the results of the investigations that a book on this subject written by the author ten years ago had to be completely revised and almost entirely rewritten in the preparation of the present volume. The plan of the book is similar to that followed in the first two volumes of the series. After an introductory chapter dealing with the general methods of formation of gels and sols of the salts, separate sections are devoted in turn to the colloidal sulphates; colloidal carbonates, phosphates, chromates, and arsenates, colloidal halides; colloidal sulphides; colloidal ferrocyanides and ferricyanides; and colloidal silicates. The first portion of each section is concerned with a critical survey of the conditions of formation and the general characteristics of the individual salts in the colloidal state; and the second portion, with the principles underlying their applications. Among the examples of colloid chemical behaviour that have received special consideration are velocity of precipitation and the physical character of precipitates; stability of sols and the mechanism of the electrolyte coagulation process; ion antagonism in colloid systems; the mutual coagulation process; adsorption on ion lattices; adsorption indicators; the colour of colloids; the permeability of membranes; and the phenomena of thixotropy and rheopexy. The principles underlying the technical applications of the colloidal salts are illustrated by chapters on plaster of Paris; lithopone and other sulphide pigments; Prussian blue; colloidal halides in photographs; base-exchange phenomenon in silicate gels; inorganic colloids of the soil; and Portland and aluminous cements.

DIE BIERHEFE ALS HEIL—NAHR UND FUTTERMITTEL. By Dr. Julius Schulein. pp. 262. Dresden and Leipzig: Theodor Steinkopff. RM11.

From time immemorial the value of live brewer's yeast as a blood-purifying agent has been recognised by country folk, particularly in Germany, where it was customary to fetch a jugful from the local brewery. Doctors had also prescribed it in certain skin diseases and gastric ailments. But its widespread adoption as a curative and nutritional agent really started only some 20 years ago when the importance of vitamins, enzymes and amino-acids to the health was being dimly realised. To-day, live yeast is established as one of the most valuable sources of the vitamin B complex. Irradiation of yeast leads to formation of vitamin D from the ergosterol present to the extent of 0.56 per cent. An important school of opinion regards brewer's yeast as more than a substitute for meat extract. To the bakery trade, on the other hand, it is of relatively minor importance owing to the superior raising powers of the artificial or so-called pressed yeasts. This well-documented work is therefore mainly of interest to manufacturers of dietetic preparations and of medicines (human and animal). The author hopes it will convince sceptics of the "great national-economic value of brewer's yeast" which contains 3 times as much vitamin B_1 and 10 times as much glutathione as pressed yeast and also a higher proportion of lecithin, choline and mineral salts.

KELLY'S DIRECTORY OF THE CHEMICAL INDUSTRIES, 1938. (20th Edition.) Kelly's Directories, Ltd. 36s.

The task of revision and correction for this edition has been fully as heavy as for any of its predecessors, and the publishers feel that this book is in every way worthy of the well-known series of trade directories of which it forms a part. This directory embraces England, Scotland and Wales, and it contains the names and addresses of those engaged in the many branches of the chemical industries, both the manufacturing and selling branches being adequately dealt with. The following headings (selected from a total of some 800) give an indication of the wide scope of the information supplied:—Chemists and Druggists, Bottle Manufacturers; Chemical Manufacturers (more than 90 separate headings); Patent Medicine Vendors; Perfumers; Mineral and Soda Water Manufacturers. The book comprises:—(1) Places section, giving the names for each county arranged alphabetically under the towns and villages; (2) an alphabetical classification of trade for the London postal district, arranged with the names under each trade heading in alphabetical order; (3) a similar classification of trades, for the rest of England, Scotland and Wales. There is also an alphabetical list of branded articles and specialities in the chemical industries, together with the names and addresses of the manufacturers

Ethylene Glycol

A Handbook of Properties and Uses

ONCE a comparatively expensive chemical, ethylene glycol is now available in bulk at prices which enable the fullest advantage to be taken of its usefulness for a wide variety of industrial applications. A new booklet ("Ethylene Glycol," pp. 27) published by Imperial Chemical Industries, Ltd., gives a valuable summary of these, with special reference to the five specific grades in which ethylene glycol is manufactured. It is a useful guide to the choice of the most suitable grade for a particular purpose, and at the same time provides a background of information which should serve to extend the applications of ethylene glycol.

Use as an Anti-Freeze

The best-established industrial use of ethylene glycol is as an anti-freeze in water cooling systems, and the theory and practice of this application is fully described, with particular reference to the grade (ethylene glycol AF) containing a corrosion inhibitor. Graphs showing the freezing points of a range of aqueous glycol solutions, useful temperature scales, and tables giving the amounts of ethylene glycol necessary at various minimum winter temperatures supply all the necessary data for its most economical use in motor-car radiators and in all cooling systems. Useful and practical handling hints, and simple examples of how to estimate the concentration of ethylene glycol necessary to give protection against minimum temperature conditions are also given.

The Air Ministry's requirements for ethylene glycol for this purpose are discussed and the advantages of high temperature cooling in aero engines briefly outlined. One of the main difficulties of high temperature cooling has been the corrosion of the liquid medium on the various metallic parts in the cooling system, and this has been to a large extent overcome by the use of a grade of ethylene glycol (ethylene glycol AM) containing a special corrosion inhibitor.

Electrolytic Condensers

The development of electrolytic condensers for radio and other work has shown that ethylene glycol is the ideal liquid dielectric for this type, so that particular interest attaches to the grade now available with a chloride content of less than 0.0001 per cent., which is without corrosive action on the aluminium plates of the condenser.

The usual type of radio condenser consists essentially of metallic plates separated by dielectrics made of such insulating material as paper or mica, usually impregnated with wax or oil. In this type the dielectric is of appreciable thickness, which means that the metallic plates are not particularly close together. Now the capacity of the condenser is dependent on the distance between the metallic plates from one another and the relationship is that the capacity is inversely proportional to the square of the distance between the two electrodes. It will be readily understood, therefore, that if the thickness of the di-electric is cut down by half, the capacity will be increased four times. In the electrolytic condenser this reduction in thickness of the dielectric is achieved by making the electrodes of metallic aluminium and providing the insulation by depositing anodically a film of aluminium oxide.

It has been found necessary to fill the spaces between the electrodes with a conducting material, and owing to its high purity and the fact that it has no solvent or corrosive action on metallic aluminium or aluminium oxide, ethylene glycol LC has been found to be a very suitable electrolyte. The function of this liquid electrolyte is twofold. Firstly, it forms a good connection between the oxide films of the dielectric, which, even when pressed closely together, obviously would only come in contact with each other at certain points. Secondly, since there may be minute holes in these oxide films sufficient to produce a leakage between the metal electrodes, it is essential for the operation of the condenser that the passage of current through the electrolyte should anodically oxidise the aluminium electrodes of these plates and thus self-heel the condenser.

Non-Corrosive Action to Aluminium

There are thus several essential differences between the electrolytic type of condenser and the older Mansbridge type. For instance, the metallic electrodes in the electrolytic condenser must be of aluminium, whereas the metal of which the electrodes of the older type of condenser are made is not important. It is also essential that the liquid electrolyte used in the electrolytic condenser should be entirely without corrosive action on metallic aluminium. Aluminium is very easily attacked by solutions which contain even the smallest traces of chlorine, and in consequence it was found necessary to reduce the chlorine content to an absolute minimum to make a suitable filling material for electrolytic condensers. This has been done and ethylene glycol LC is the result.

Brief notes are also given of other varied uses of ethylene glycol, including that of a hygroscopic agent and plasticiser in the manufacture of transparent paper and gelatine printing rollers; as a basic dyestuff solvent to give improved colour value in the manufacture of spirit inks; and as a chemical intermediate.

A very detailed table of physical properties and a bibliography complete a most useful summary.

Soap Manufacture from Synthetic Fatty Acids

Progress of German Methods

AT a recent conference of the German soap manufacturers held in Hamburg, Dr. Gustav Wietzel, of the Oppau Research Laboratory of the I. G. Farbenindustrie, delivered a lecture on the production of soap from synthetic fatty acids, which is reported in *Deutsche Bergwerks Zeit.*, September 6.

Hitherto Germany has been dependent on imports for more than half of the fat required for food and for industrial purposes, and the expenditure for these fat imports has been round 400 million RM yearly. Of an annual consumption of industrial fats amounting to about 368,000 tons, about 70 per cent. has been used in soap production. German chemists, and particularly those of the Werkes Ludwighafen-Oppau, have in recent years succeeded in finding a satisfactory technical process for the synthetic production of fatty acids from solid paraffin which promises to become of great importance in the future. The fatty acids are the most important constituents of fats in the manufacture of soaps. They are distinguished from the paraffin raw material in that at the end of the molecular chain of 10-20 carbon atoms, the group CH_3 is displaced by the COOH group. This involves a combination of oxygen in the paraffin molecule, and the splitting off of hydrogen as water to obtain the fatty acids.

This apparently rather simple operation is actually accompanied by a series of difficulties, as the oxygen forms not only the desired COOH group, but a number of others which,

on account of unpleasant odour and other unwelcome properties, must be separated from the fatty acids. It is therefore necessary that the product obtained by treating the paraffin with oxygen or air be subjected to subsequent treatment to yield fatty acids of sufficient purity for soap making.

The fatty acid synthesis thus falls into two stages: The first is the oxidation stage, and the second is the preparation stage, which includes saponification of the oxidised products, separation of the unsaponifiable products, splitting of crude soap, and distillation of the crude fatty acids. Between these stages, and before oxidation, operations such as washing, bleaching, filtration, and the like, are necessary. In the oxidation stage air is blown through the molten paraffin at temperatures between 90 and 160° C. for about 10 hours. A number of conditions must be observed in order to obtain good results, which include the use of suitable catalysts, the maintenance of an optimum temperature, the right measurement and distribution of the oxidising air, and the breaking off of oxidation at the right stage.

The preparation stage begins with the washing of the oxidation products with an aqueous solvent; the washed product is then treated with a lye, and can then be freed from unsaponifiable constituents in two different ways. The first method is to extract these with solvents in which only the unsaponifiable constituents are soluble, and the other method is to distil them off at a sufficiently high temperature, based on experience in coal hydrogenation and petroleum-refining practice. In both cases the remaining crude soap is split by the use of a dilute acid, and the fatty acids set free. These are separated by distillation into fractions specially suited for soap manufacture.

Dr. Wietzel also gave a brief history of the development of the synthetic fatty acid process. He said that in 1884 Schaal attempted to manufacture fatty acids by the oxidation of paraffin, but failed to obtain technically useful products. In the early post-war years the oxidation of paraffin was attempted by a number of persons without obtaining a satisfactory technical solution. In 1921 the I. G. Farbenindustrie began systematic investigation of the problem, and succeeded in developing a practical process for the production of synthetic fatty acids of a high degree of purity. In 1928 this concern produced several tons of synthetic fatty acids in a semi-commercial experimental plant, and distributed these to different German soap manufacturers for testing as to their suitability for the soap-making industry. The present process, which is the subject of numerous patents, is the result of improvements of the original in recent years, both in respect of output and the quality of the products.

The possibility of large scale production of synthetic fatty acids in Germany depends on the quantity of the solid paraffin raw material becoming available, but in some other countries where the paraffin basis is considerable, the I. G. Farbenindustrie's process has created very much interest. In 1931 a commercial works for the manufacture of 1,000 tons of synthetic fatty acids was erected, and brought into operation at Baton Rouge in the United States under the joint auspices of the I. G. Farbenindustrie and the Standard Oil Co. In 1937 a commercial plant for the manufacture of fatty acids by the process came into operation in Germany, and in the same year the Deutschen Fettsaurewerke and the I. G. Farbenindustrie agreed to operate these works in common.

Organic Accelerators in the Rubber Industry

By
T. L. GARNER

THE use of organic substances to accelerate the rate of vulcanisation of rubber has not been of any great importance for more than the past fifteen years, although the original discovery that aniline and similar materials exerted an accelerating effect was made in 1906. The use of such accelerators, which have only a mild action combined with excellent softening properties, did not develop until several years later, when it was discovered that they were far too toxic for general factory use. From this point new derivatives were prepared from these bases with a view to rendering the poisonous NH_2 group innocuous, most of the modifications taking the form of aldehyde-amines on account of the ease of production of such compounds. Later work showed that while the original idea of making the accelerator non-toxic was achieved, the aldehyde played a much more important part than this and frequently very active forms of accelerators resulted which conferred on the rubber containing them valuable properties, particularly as regards ageing resistance.

Obviously, development of accelerators of the aldehyde-amine type also lead to research along other lines of reaction with the NH_2 grouping and an accelerator which resulted from the condensation of aniline with carbon bisulphide, thiocarbanilide, became of the greatest importance in the industry.

$$2C_6H_5.NH_2 + CS_2 \rightarrow \begin{matrix} C_6H_5.NH \\ C_6H_5.NH \end{matrix} \Big\rangle CS$$

While by no means a perfect type of accelerator as judged by modern standards, thiocarbanilide was a satisfactory compound to handle in the comparatively early days and from this has been developed two modern accelerators, mercaptobenzthiazole and diphenylguanidine, which have been the most widely used types during the last ten years.

The use of organic accelerators has revolutionised the industry and the improvement which has resulted from their use, for example in motor tyre construction, has been outstanding. In addition they have resulted in very considerably increased production through shortening of times of vulcanisation and have paved the way for the successful use of many cheaper rubber compounds. Naturally the number of new types which have been suggested has, as a result of the great demand created, been very great but probably there are not more than twenty or thirty different commercial organic accelerators in use to-day.

In general it can certainly be argued that any one rubber factory has no call to use more than about half a dozen different accelerators for its various products if these are carefully chosen. These must include medium, fast and probably one member of the ultra accelerator class, and not only is their choice a difficult one in the first place if all grades of products are to be successfully and economically provided for without causing trouble with scrap disposal, but the regular examination of new types must be carefully carried out with a view to substituting any one which is less efficient from all angles than the new material.

Mercaptobenzthiazole

Mercaptobenzthiazole, which has easily been the most popular accelerator in recent years, is the outstanding medium-fast accelerator of the sulphur class. As with most organic accelerators, the presence of a mineral oxide such as zinc oxide is necessary to activate this accelerator, but the type is different to others in that the presence of fatty acid, such as stearic, is also essential. Mercaptobenzthiazole has the advantage from the user's point of view that its purity can be determined by simple alkali titration, whereas with other accelerators, such as aldehyde-amines this is impossible; variation is thus detectable by laboratory testing. In use the accelerator is active at temperatures between 255 and

305° F., and the fact that satisfactory physical properties, including ageing, are shown over a wide range of vulcanisation is particularly important commercially. Given reasonable factory precautions, troubles with prevulcanisation of mixed rubber stocks do not arise, and its excellent properties coupled with the low price at which it is marketed will probably result in its continued popularity for a long time to come.

Various modifications of mercaptobenzthiazole have been suggested following its great popularity; for example, the zinc salt which is considered to be safer in the factory in handling and less likely to give rise to any scorching trouble.

Tetramethyl thiuram mono- and disulphides are other accelerators in this class of importance, particularly the former which, used in the normal way with sulphur is a powerful ultra-accelerator. Actually its use as a primary accelerator in this manner is very limited, but it is largely used as a secondary accelerator for boosting the modulus and tensile strength of rubber stocks, for example, those vulcanised with mercaptobenzthiazole. Such compounds are not necessarily more difficult to handle and the results thus obtained are quite different from those possible with the primary accelerator above.

Another important use of tetra methyl thiuram disulphide is as a vulcanising agent in the absence of sulphur. This accelerator contains 13.3 per cent. of its weight of sulphur in such a form of combination that it is available for vulcanisation, and consequently mixes containing larger quantities of it than are used when accelerating sulphur-vulcanised stocks are capable of vulcanising the rubber without the addition of sulphur in any other form. For this purpose 2 to 4 per cent. on the rubber are normally employed and stocks produced in this way are particularly resistant to heat and deterioration by ageing.

Guanidines

There are three guanidines which in the past have found favour as accelerators, particularly diphenylguanidine, although their use has considerably diminished in favour of superior types. The triphenylguanidine is a comparatively slow accelerator which was largely used for the production of bulky rubber articles such as solid tyres, where the heat takes some time to reach the centre of the article, and a more rapid accelerator would over-vulcanise the outside before the interior had reached vulcanising temperature. Diphenylguanidine is a medium active accelerator which was at one time the most popular in use because of its wide range of activity, ease of handling, and low cost. The ageing properties of stocks containing it are not very good, however, and its use is declining in favour of other accelerators, such as mercaptobenzthiazole, which are superior in this respect.

The combination of diphenylguanidine and mercaptobenzthiazole produces an ultra accelerator very liable to give scorching trouble and consequently the use of both these types in a shop where the rubber qualities may be mixed in the form of scrap is not to be recommended on this account. The other guanidine, diorthotolylguanidine, is somewhat similar to diphenylguanidine in activity, but it gives better results in brightly coloured rubbers.

Aldehyde Amines

This type of compound forms easily the largest class of organic accelerators and over thirty different varieties have at one time or another been on commercial sale. Acetaldehyde, formaldehyde, butyraldehyde, and Gurfural aldehyde are the chief aldehydes which have been used to produce this class of accelerator by combination with aniline, toluidine, and other amines. They are frequently offered in liquid form and among the many varieties will be found medium to active types, operating efficiently between 260 and 320° F. All these accelerators have the advantage of giving valuable age-resisting properties to the rubber and the necessity for an antioxidant is thereby lessened.

In the early days, hexamethylenetetramine was a very popular accelerator, but this has been eliminated because of its toxicity in favour of other members of the class without any such disadvantage. Generally, all the accelerators of this type give soft rubber stocks, as compared with those produced from tetramethylthiuram disulphide which are much more "snappy" and for this reason they are used in the production of rubber where high stretch with good recovery and good ageing properties are desired, for example, in a motor tube stock.

Ultra-Accelerators

There are quite a number of accelerators in commercial use which are very active types. Tetramethylthiuram disulphide is one of these which has already been mentioned and the ethyl derivative is similar, although having the advantage of being less liable to scorching. Another type of ultra accelerator is illustrated by zinc dimethyldithiocarbamate, which is extremely powerful in action and capable under certain conditions of effecting vulcanisation at or below the temperature of boiling water. It is too active used alone in a rubber mix for dry stocks, but can be used in this way for preparing rubber cements; as a secondary accelerator, however, it can be used satisfactorily for boosting the rate of vulcanisation. There are other accelerators of this type which differ in various respects; thus diethylammonium diethyl dithiocarbamate is a water-soluble accelerator still more active than the above, which is used in late work.

The xanthates form another class of ultra accelerator; thus zinc isopropyl xanthate is an active special purpose accelerator mainly used for self-vulcanising cements. This accelerator cannot be used efficiently at temperatures much over 100° C., because of decomposition and in any case when used in a dry batch the utmost care is necessary to prevent pre-vulcanisation. Sodium isopropyl xanthate is the water soluble form for latex work.

Delayed Action Accelerators

The fast rate of vulcanisation of some of the ultra accelerators not unnaturally attracted great interest in commercial practice, but the difficulty of handling in dry mixing for general purposes prevented any great extension of their use. Research work was therefore directed to the production of accelerators which would act very swiftly at the higher temperatures used in vulcanising presses, but be quite inactive at the ordinary processing temperatures used in the factory; so-called delayed action accelerators have thus been originated and are becoming increasingly popular. With these a suitable combination has been made which raises the critical temperature of the mix, or the temperature at which promotion of vulcanisation begins, so as to render the mix more fool-proof in factory handling. At the same time above the critical temperature the accelerator is rapid in action so that vulcanising times are not increased. Such accelerators are frequently inactive at temperatures up to 100° C., and it is obvious that mixes containing them can be treated with much less care without trouble developing than when using an ordinary accelerator with a progressive vulcanising curve.

The choice of an organic accelerator depends on several factors, one of the most important in many cases being the cost. Diphenyl guanidine was for a number of years the cheapest general purpose accelerator and it held premier position on this account. Other accelerators have better ageing qualities, however, and with the growth in importance of motor tyre manufacture, mercaptobenzthiazole with its superior properties was preferred. The greatly increased demand has led to this moderately powerful accelerator being available at a very low price. It is an acidic accelerator and can give rise to scorching trouble in mixes if they are carelessly handled, but with reasonable precautions little trouble is experienced; because of this, however, the zinc salt has been put forward as of the same type, but free from tendency. Delayed action accelerators when

properly chosen and applied are obviously the safest for factory processing and satisfactory physical properties are obtained from them; they are, however, more expensive and cannot always be used on this account, even allowing for savings resulting from their safe operation and consequent lower scrap. The factory range will undoubtedly include one or two moderately fast accelerators, a delayed action type and one or two ultra accelerators, in order to cover satisfactorily all requirements.

The range should be selected with an eye to the behaviour of these accelerators on mixing, since, especially in a general moulding shop, scrap is sure to be mixed and returned with two or more qualities present from time to time. If the accelerators "agree," then no harm will be done in scrap disposal, but in some cases a combination in this way will produce a fiery mixture which will lead to premature vulcanisation, often spoiling the batch to which the returned scrap may be added for re-use. A particular example is mixes containing on the one hand diphenylguanidine and on the other mercaptobenzthiazole, and it is always dangerous for the scrap from these to be mixed. Attention to this aspect of accelerator choice is of great importance in a factory if scrap is to be kept at a minimum.

The smaller the number of accelerators on which the mixes can be satisfactorily run is also obviously the better and the introduction of a new one should as far as possible only take place at the expense of a less useful existing one. In this choice, the particular physical properties will, of course, be noted and also the type of vulcanising curve, an accelerator which shows the so-called "plateau effect," i.e., gives the same properties over a wide range of vulcanisation, being preferable to one which gives its best properties only over a very short range and shows a decided peak in its vulcanisation-time curve.

In general, the necessity for using more than one accelerator in a mixing, other than using a second accelerator in small amounts to boost the vulcanisation rate, is not necessary although formerly this was frequently practised. Many of the modern accelerators, particularly of the delayed-action type are combinations already which achieve what the compounder was formerly attempting to do himself.

Indian Rice Crop

A New Fertilising Problem

A DISCOVERY, which may lead to a revolutionary advance in the production of the Indian rice crop, has been made by Mr. P. K. De, writing in collaboration with Professor F. E. Fritsch, head of the department of Botany at Queen Mary College, University of London.

For centuries, the Indian rice crop, despite the absence of any artificial manuring, has continued to yield with undiminished vigour. It was clear that the plant was being fertilised from some source, and expert opinion turned to the possibility that the soil's vital supply of nitrogen came from the green slime (or algæ) which forms when the rice fields are waterlogged. Mr. De, of the University of Dacca, Bengal, was sent, two years ago, by the Imperial Council of Agricultural Research, to Queen Mary College, where he has succeeded in establishing beyond all question that the fertilising source of the rice fields is in fact the algæ.

It was necessary first to separate the specimens of the algæ from all alien matter and bacteria, a task involving many disappointments and endless patience. However, the job has been done and for the first time, the fact has been established that algæ act as a fertilising agent. According to Mr. De, now that we know what has contributed to the life of the rice, century after century, we must turn our attention to the second problem—how to encourage the growth of the algæ. That, however, will not be easy, for we shall have to be quite sure that we are not, by artificially stimulating the algæ, thereby injuring the rice plant.

Letter to the Editor

The Words of a Distinguished Frenchman

SIR,—In all this welter of politics, the words of Anatole France spoken to me a year after the war seem to be coming true. This great philosopher and Frenchman of the French said:

"The most horrible of wars is followed by a treaty which is not a treaty of peace, but a prolongation of the war. The downfall of Europe is inevitable unless at long last a spirit of reason is imported into its councils, and many poor creatures open their mouths to speak of matters of which they obviously know absolutely nothing."

These remarks were printed and evoked a perfect storm of protest in France at the time. This prophecy seems to be coming true.—Yours faithfully,

W. LLOYD WILLEY.

5 Vanbrugh Fields,
Blackheath, S.E.3.

Facing the Crisis

No Dislocation of Business

AT the request of Sir Ernest Benn the staffs of THE CHEMICAL AGE and the other trade and technical journals published by Benn Brothers, Ltd., assembled in the reception room at Bouverie House on Friday, September 30.

Sir Ernest Benn, in a short address, said that he jumped at the opportunity of saying how proud he was of everybody in Bouverie House, and of the sane and steady attitude which had permeated the whole staff. There was not a single director who could say that even one member of the staff had been to him in a state of panic during the whole crisis. That was a remarkable record of which all might be proud. They had suffered no dislocation of business. It was now possible to look forward to a good winter's work in the knowledge that the crisis had passed. He knew they would get on with the job as they had done in the past.

Institute of Vitreous Enamellers

Fifth Annual Conference

THE Institute of Vitreous Enamellers will hold their 5th annual conference at Hotel Normandie, Knightsbridge, London, October 28-30.

On Friday, October 28, the president, Sir Harold Hartley, F.R.S., will preside over the annual general meeting in the afternoon, and over the banquet in the evening (accompanied by Lady Hartley). He will be supported by many prominent leaders of industry, commerce, and science, closely connected with the enamelling industry.

A paper on "Scientific Aids to Vitreous Enamelling" will be presented by J. G. Pearce and G. T. O. Martin, followed by discussion, on Saturday, October 29. On Sunday, October 30, there will be a motor coach trip to Hampton Court, Chertsey, Windsor, Eton and Staines.

ACCIDENT CONGRESS IN UNITED STATES

MORE than 10,000 men and women from all parts of the world are assembling in Chicago, October 10-14, as delegates to the National Safety Council's Silver Jubilee Safety Congress and Exposition. This congress will celebrate the council's 25 years of accident fighting, encouraged by reports of sustained improvement in the nation's accident troubles since the last congress a year ago. All kinds of accidents—industrial, traffic, home and public—will come under the scrutiny of the delegates. The congress will be accompanied by more than 130 exhibits, both commercial and contributive.

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Personal Notes

MR. E. COLLINS has been appointed government analyst at Mauritius.

MR. GEORGE BREARLEY, B.Sc, manager of the Mersey Chemical Works, has been appointed a director of Brotherton and Co., Ltd.

MR. T. H. MONTGOMERY, for 20 years traffic manager at Cookson's Lead and Antimony Works, Willington Quay, Wallsend, has retired.

The late MR. EDMUND WATSON SLEATH, of Alderley Edge, and of Manchester, manufacturing chemist, left gross estate of the value of £113,737, with net personalty £107,295.

PROFESSOR G. F. MARRIAN, D.Sc., has been appointed to the chair of chemistry in relation to medicine at Edinburgh University. He succeeds Professor George Barger, now Regius professor of chemistry in Glasgow University. Professor Marrian is at present associate professor of biochemistry at Toronto University.

MR. GEORGE E. BARKER, Ph.D., Massachusetts Institute of Technology, 1934, has been appointed incumbent of a new Fellowship established at Mellon Institute by the Elgin National Watch Co. The research programme will cover the chemical aspects of technical problems in the watch industry, one of the first subjects of investigation being watch lubrication. Dr. Barker has spent several years in the synthetic organic chemical industry.

PROFESSOR R. H. FOWLER, F.R.S., at his own request for reasons of health, has been released from his engagement to assume the directorship of the National Physical Laboratory in succession to Dr. W. L. Bragg. DR. C. G. DARWIN, F.R.S., Master of Christ's College, Cambridge, has now been appointed to the post. For the period until Dr. Darwin can assume his duties the office of director will be held by Sir Frank Smith, the secretary of the Department of Scientific and Industrial Research.

DR. HERMANN FINK, who is professor of the biochemistry and technology of fermentation at the University of Basle, has been awarded the Scheele medal by the Stockholm Chemical Society.

MR. ARCHIBALD MACMILLAN, who has been employed on the laboratory staff of the British Aluminium Co. at Kinlochleven for the past 15 years, has left to become assistant foundry manager with Birmetals, Ltd., Birmingham.

MR. ISAAC BAKER, manager of the Staveley Coal and Iron Co.'s Devonshire Works blast furnaces, is to retire from office, and will shortly leave Barrow Hill to reside at New Whittington. He will be succeeded by his 50-year-old son, Mr. Isaac Edward Baker, now assistant manager.

PROFESSOR FLORENCE BARBARA SEIBERT, assistant professor of biochemistry at the Henry Phipps Institute of the University of Pennsylvania, Philadelphia, has received the Trudeau medal in recognition of researches on the chemistry of protein molecules derived from the tubercle bacillus. She is the first woman to be awarded the Trudeau medal.

DR. EDGAR RHODES, who has been working at the Rubber Research Institute in Malaya, is returning to England to take up the post of senior rubber technologist to the British Rubber Producers' Research Association. His new work will be concerned partly with watching the progress of synthetic rubber with a view to preventing it securing preference over crude natural rubber. Dr. Rhodes is a native of Bradford and graduated at Leeds University. He went to the Rubber Research Institute, Malaya, in 1927, having previously served as biochemist to the British Cotton Industry Research Association at Manchester. He is recognised in both England and America as a leading rubber scientist.

OBITUARY

MAJOR NORMAN MACKEAN, of William MacKean, Ltd., starch manufacturers, Paisley, has died at the age of 77.

From Week to Week

WORK HAS BEEN COMPLETELY STOPPED at the Clyde Soya Meal Factory, Glasgow, owing to a strike involving more than 100 men.

THREE MEN WERE KILLED and 34 were injured in a series of explosions in the oil-extracting plant of a factory at Marseilles this week.

THE SQUIBB INSTITUTE FOR MEDICAL RESEARCH, New Brunswick, N.J., is to be opened on October 11. It has been established as one of the interests of E. R. Squibb and Sons.

NORGINE PHARMACEUTICAL PRODUCTS (LONDON), LTD., of 3/4 Clement's Inn, Kingsway, W.C.2, have increased their nominal capital by the addition of £7,000 in £1 ordinary shares beyond the registered capital of £5,000.

THE 1938 ISSUE of the *Soap Makers' Directory* has been published (price 2s. 6d., post free 2s. 10d.). This directory gives full information in connection with the important industry it represents. The addition of a candle makers' directory within its pages makes it doubly valuable.

A DEMONSTRATION OF DIFFERENCES in the wear resistance of hot and cold metals will be featured at the Haynes Stellite Co. exhibit at the National Metal Exposition in Detroit, October 17 to 21. A large high-pressure steam valve, cut away and illuminated from the interior, will continuously open and close to show the type of service which alloy-coated seating surfaces must withstand. A display emphasising the corrosion resistance of certain alloys to chemical solutions will be so arranged that, by pressing a button, visitors will be able to immerse specimens alternately in corrosive solutions for comparison.

THE IMPORT DUTIES ADVISORY COMMITTEE announce that they have under consideration proposals for the variation of the existing arrangements governing supplies and prices of Empire zinc and the import duty on foreign zinc, and in particular for an increase in the present rate of duty. Any representations which interested parties may desire to make in regard to this matter should be addressed in writing to the Secretary, Import Duties Advisory Committee, Shell-Mex House, Strand, London, W.C.2, not later than October 21, 1938.

THE ANNUAL DINNER and Carnival Dance of the Manchester Section of the Oil and Colour Chemists' Association will be held on November 4.

THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN announce that the official opening of the College of Pharmacy, which had been arranged for October 5, was cancelled.

INCREASING DEMAND for stand-by lighting plant has induced R. A. Lister and Co., Ltd., of Dursley (Glos.), to open a special department in London. This department will assist public authorities, institutions and other large users of electricity to complete plans for meeting emergencies.

A REPRESENTATION HAS BEEN MADE to the Board of Trade under Section 10(5) of the Finance Act, 1926, regarding lithium fluoride crystals not less than 1 centimetre in any dimension. The section permits the Treasury to exempt from key industry duty any article not made in the Dominions in substantial quantities.

A BUS DRIVEN BY COAL-GAS is to be run by the Glasgow Corporation on one of their regular passenger routes for a month. This bus, which is the only one of its kind in Britain, is owned by the Highland Transport Co., and it has been brought to the notice of the Corporation by the Scottish Area Committee of the Coal Utilisation Council.

THE MANCHESTER SECTION of the Oil and Colour Chemists' Association will hold a special general meeting at the Chemical Club, Constitutional Club, St. Ann's Street, Manchester, on October 21 at 7 p.m., at the request of the Council, to secure views on the new rules and to give every member an opportunity to voice his own opinion.

THE INSTITUTION OF CHEMICAL ENGINEERS will hold a joint meeting with the Incorporated Association of Rating and Valuation Officers on October 11, at 6 p.m., at the Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, when Mr. P. Michael Faraday will present a paper on "Principles and Practice of Rating of Industrial Concerns, with special reference to Chemical Works." The chair will be taken by the president, Dr. William Cullen.

IMPERIAL CHEMICAL INDUSTRIES, LTD., announce the introduction of Duranol Dark Brown B, Duranol Dark Green B, and Duranol Navy Blues EG and ER, as basis for the economical production of nigger brown, bottle green and dark navy blue shades. All four products are in the form of readily dispersible powders.

A REPRESENTATION HAS BEEN MADE to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding caesium bromide. Any communications should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, London, S.W.1, before October 21, 1938.

THE BRITISH ROAD TAR ASSOCIATION will hold a luncheon at Grosvenor House, Park Lane, London, W.1, on Thursday, November 3, at 1 p.m. for 1.15 p.m. (prompt) on the occasion of the annual meeting of the Association. The annual meeting itself will be private, but the President will review road matters generally in a short speech at the luncheon, and after this address the Association's new film entitled " Tar Carpets " will be shown.

THE FENLAND BEET-SUGAR CAMPAIGN begins this week. At the Spalding factory considerable improvements have been made in the yard by the installation of an Elfa plant for unloading beet by water power.

IT IS REPORTED FROM ADELAIDE that good progress is being made in the underwriting of shares to be issued by the £1,000,000 company which is being floated in Adelaide with the co-operation of the South Australian Government, to manufacture cartons, wrappings, and other products from straw.

THE PAINT RESEARCH STATION has published a booklet entitled *Priming Joinery Timber*, following the decision of the council of the Association to release for general publication such of their bulletins on appropriate subjects as are of interest to those concerned with the craft of painting. It is pointed out that there is now a tendency to sacrifice adequate preparation and treatment of building materials for speed of construction, false economies, and a mere superficial appearance of soundness in the finished work.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Complete Specifications Open to Public Inspection

REMOVAL OF SULPHUR DIOXIDE from gases.—Board of Trustees of Illinois University. March 24, 1937. 15222/37.

RUBBER HYDROHALIDES.—Wingfoot Corporation. March 23, 1937. 31448/37.

TREATMENT OF SPENT ALKALI METAL HYDROXIDE REAGENT from caustic alloy refining processes.—National Lead Co. March 25, 1937. 36095/37.

ELECTROLYTIC PRODUCTION OF OXIDE-CONTAINING COATINGS on aluminium-free magnesium alloys.—Siemens and Halske, A.-G. March 25, 1937. 1560/38.

HYDROCARBON FUEL TREATER.—A. E. McManus. March 20, 1937. 36281/37.

ROTARY TUBE-FURNACES for metallurgical or chemical purposes. Metallges, A.-G. March 20, 1937. 2311/38.

WETTING, SUDSING, EMULSIFYING, AND DETERGENT AGENTS.—Procter and Gamble Co. March 26, 1937. 3046/38.

PRODUCTION OF GAS MIXTURES rich in hydrogen.—Ges Fur Linde's Eismaschinen. March 20, 1937. 6706/38.

EXTRACTION OF BERYLLIUM COMPOUNDS from beryllium ores.—Seri Holding Soc. Anon. March 20, 1937. 7144/38.

POLYHYDRIC ALCOHOL-POLYCARBOXYLIC ACID CONDENSATION PRODUCTS.—I. G. Farbenindustrie. March 20, 1937. 7880/38.

PRODUCTION OF DRY TRITURATIONS.—G. Madaus, F. Madaus, and H. Madaus (trading as Dr. Madaus and Co.). March 23, 1937. 6734/38.

MANUFACTURE OF AZO-DYESTUFFS and derivatives thereof.—E. I. du Pont de Nemours and Co. March 23, 1937. 8305/38.

PROCESSES FOR THE MANUFACTURE OF PRODUCTS from animal fibres.—Hansa-Werke Lurman, Schutte and Co. March 20, 1937. 8438/38.

VARIABLE RESISTANCES and potentiometers.—Steatit-Magnesia, A.-G. March 20, 1937. 8554/38.

MANUFACTURE OF MILD STEEL.—Rochling'sche Eisen-Und Stahlwerke Ges. March 22, 1937. 8593/38.

PROCESS FOR THE MANUFACTURE OF BERYLLIUM OXIDE.—Seri Holding Soc. Anon. March 23, 1937. 8671/38.

MANUFACTURE OF SYNTHETIC RUBBER-LIKE MATERIALS.—I. G. Farbenindustrie. March 20, 1937. 8672/38.

METHOD OF AND APPARATUS FOR OBTAINING OR PURIFYING THERAPEUTICALLY EFFICACIOUS PREPARATIONS.—F. Schutz. March 23, 1937. 8652/38.

DERIVATIVES OF CYCLOPENTANO-DIMETHYL-POLYHYDRO-PHENANTHRENE and the manufacture thereof.—Naamlooze Vennootschap Organon. March 22, 1937. 8658/38.

PRODUCING ALPHA-SUBSTITUTED GLYCEROL NITRATES.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. March 22, 1937. 8670/38.

METHOD OF MANUFACTURING SODIUM CARBONATE.—L. Champy, and A. J. Noordam. March 20, 1937. 8683/38.

SATURATED AND UNSATURATED DERIVATIVES OF PREGNANE DIONE and the manufacture thereof.—Naamlooze Vennootschap Organon. March 24, 1937. 8830/38.

POLYMERISATION OF OLEFINES.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. March 26, 1937. 8946/38.

Specifications Accepted with Dates of Application

APPARATUS FOR THE PRODUCTION OF OZONE.—F. C. Sutton and R. J. Browne. March 23, 1937. 492,647.

PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF FILMS, foils, bands, and the like from cellulose solutions.—E. Czapek. Dec. 17, 1935. 492,370.

DRYING CELLULOSE PELLICLES.—E. Czapek. Dec. 17, 1935. 492,371.

APPARATUS FOR THE PRODUCTION OF ENDLESS LENGTHS OF FOILS, films, and the like from cellulose solutions.—E. Czapek. Dec. 21, 1935. 492,372.

RUBBER and the like processes and products.—T. L. Shepherd. Jan. 20, 1937. 492,439.

MANUFACTURE OF COMPOUNDS of the androstane and pregnane series.—A. G. Bloxam (Soc. of Chemical Industry in Basle). Feb. 18, 1937. 492,377.

MANUFACTURE OF SOAP-FORMING CARBOXYLIC ACIDS.—Deutsche Hydrierwerke, A.-G. Feb. 20, 1936. 492,595.

REMOVING METAL OXIDES, and preparations therefor.—W. W. Groves (I. G. Farbenindustrie.) March 17, 1937. 492,526.

ISOLATION OF ZEIN.—J. E. Pollak (Interational Patents Development Co.). March 18, 1937. 492,599.

PRODUCTION OF ZEIN.—J. E. Pollak (International Patents Development Co.). March 18, 1937. 492,600.

PRODUCTION OF PROTEIN PLASTICS.—J. E. Pollak (International Patents Development Co.). March 18, 1937. 492,652.

PRODUCTION OF PLASTICS COMPRISING ZEIN.—J. E. Pollak (International Patents Development Co.). March 18, 1937. 492,653.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

British India.—H.M. Trade Commissioner at Calcutta reports that the Indian Stores Department is calling for tenders (Tender No. M. 3240) for the supply and delivery of quantities of first and second quality fuel oil and Palanyon oil as and when required during the period March 1, 1939, to February 29, 1940. The oil is required for internal combustion engines of the semi-diesel and diesel type and for burning in boiler furnaces. Tenders should be addressed to the Chief Controller of Stores, Indian Stores Department, Miscellaneous Branch, New Delhi, India, by whom they will be received up to December 13, 1938. Tenderers should submit samples of the oils they propose to supply to the Superintendent, Government Test House, Alipore, Calcutta, by November 30, 1938. In cases where samples have already recently been tested by the Superintendent, the number and date of the Test certificate only need be quoted. (Ref. T. 27262/38.)

British India.—H.M. Trade Commissioner at Calcutta reports that the Indian Stores Department is calling for tenders (Tender No. M. 3220) for the supply and delivery of lubricating oils and greases as and when required during the period from March 1, 1939, to February 29, 1940. Tenders should be addressed to the Indian Stores Department, Miscellaneous Section, New Delhi, where they will be received up to October 26, 1938. (Ref. T. 27261/38.)

New Zealand.—A well-established firm of agents at Auckland wishes to obtain the representation, on a commission or purchasing basis, of United Kingdom manufacturers or exporters of oils, paints and varnish for New Zealand. (Ref. No. 236.)

Chile.—A firm of agents established at Santiago wishes to obtain the representation, on an outright buying basis, of United Kingdom manufacturers of soda ash, impure caustic soda, solid paraffin, ammonium chloride, liquid sodium silicate, bicarbonate of soda, litharge, crude and boiled linseed oil, gum arabic, shellac, red lead, ultramarine blue, white lead, haematin, colophony, fibrous asbestos, for Chile. (Ref. No. 242.)

Weekly Prices of British Chemical Products

NOW that the period of acute anxiety has happily passed, conditions in the general chemical market this week may be characterised as quiet and steady with trade in most sections on a normal basis. A number of orders for stock requirements placed during the previous week have yet to be executed and there are no indications that buyers have any desire to cancel such orders. No official price changes fall to be recorded and quotations remain steady, with the undertone perhaps a little firmer. The coal tar section has a decidedly firmer appearance and in some directions, notably for carbolic acid crystals, quotations have displayed an upward tendency. The volume of actual business being done, however, is of small dimensions and both holders and buyers seem content to mark time until the outlook becomes less obscure.

MANCHESTER.—Trading conditions on the Manchester chemical market during the past week have been more or less normal after the extreme nervousness of a week ago and business has been no more than moderate so far as new bookings are concerned, with users who are not already well covered for supplies content to operate on a near delivery basis. There is a good deal of room for improvement regarding the rate at which contract deliveries are being called for in the textile chemical section, but in other directions specifications are coming through fairly regularly. Prices generally are steady. In the tar products market there has been a fair demand about for crude tar, benzole, pure toluol, naphthas and pyridine, with sales of crude naphthalene a little better.

GLASGOW.—Since our last report, business in general chemicals has become much quieter, buyers now showing a tendency to delay further purchases. Prices, however, continue quite firm at about previous figures, with no important changes to report.

Price Changes

Rises: Cresylic Acid, pale 99/100% (Manchester); Pyridine (Manchester); Copper Sulphate (Scotland.

Falls: Naphthalene, refined (Manchester).

General Chemicals

ACETONE.—£45 to £47 per ton.

ACETIC ACID.—Tech, 80%, £30 5s. per ton; pure 80%, £32 5s.; tech., 40%, £15 12s. 6d. to £18 12s. 6d.; tech., 60%, £23 10s. to £25 10s. MANCHESTER: 80%, commercial, £30 5s.; tech. glacial, £42 to £46.

ALUM.—Loose lump, £8 7s. 6d. per ton d/d; GLASGOW: Ground, £10 7s. 6d. per ton; lump, £9 17s. 6d.

ALUMINIUM SULPHATE.—£7 2s. 6d. per ton d/d Lancs. GLASGOW: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 1s. to 1s. 1d. per lb. d/d in cylinders. SCOTLAND: 10½d. to 1s. 0½d., containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM CARBONATE.—£20 per ton d/d in 5 cwt. casks.

AMMONIUM CHLORIDE.—Grey, £18 10s. per ton, d/d U.K. Fine white, 98%, £17 per ton, d/d U.K.

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

AMMONIUM DICHROMATE.—8¼d. per lb. d/d U.K.

ANTIMONY OXIDE.—£68 per ton.

ARSENIC.—Continental material £11 per ton c.i.f., U.K. ports; Cornish White, £12 5s. to £12 10s. per ton f.o.r., mines, according to quantity. MANCHESTER: White powdered Cornish, £16 10s. per ton, ex store.

BARIUM CHLORIDE.—£11 10s. to £12 10s. per ton in casks ex store. GLASGOW: £11 10s. per ton.

BLEACHING POWDER.—Spot, 35/37%, £9 5s. per ton in casks, special terms for contracts. SCOTLAND: £9 per ton net ex store.

BORAX COMMERCIAL.—Granulated, £16 per ton; crystal, £17; powdered, £17 10s.; extra finely powdered, £18 10s., packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Granulated, £16, crystal, £17; powdered, £17 10s. per ton in 1-cwt. bags, carriage paid.

BORIC ACID.—Commercial granulated, £28 10s. per ton; crystal, £29 10s.; powdered, £30 10s.; extra finely powdered, £32 10s. in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Crystals, £29 10s.; powdered, £30 10s. 1-cwt. bags in 1-ton lots.

CALCIUM BISULPHITE.—£6 10s. per ton f.o.r. London.

CHARCOAL, LUMP.—£6 to £6 10s. per ton, ex wharf. Granulated, £7 to £9 per ton according to grade and locality.

CHLORINE, LIQUID.—£18 15s. per ton, seller's tank wagons, carriage paid to buyer's sidings; £19 5s. per ton, d/d in 16/17 cwt. drums (3-drum lots); £19 10s. per ton d/d in 10-cwt. drums (4-drum lots); 3½d. per lb. d/d station in 70-lb. cylinders (1-ton lots).

CHROMETAN.—Crystals, 2¾d. per lb.; liquor, £13 per ton d/d station in drums. GLASGOW: 70/75% solid, £5 15s. per ton net ex store.

CHROMIC ACID.—10d. per lb., less 2½%; d/d U.K.

CHROMIC OXIDE.—11d. per lb.; d/d U.K.

CITRIC ACID.—1s. 0¼d. per lb. MANCHESTER: 1s. 0¼d. SCOTLAND: B.P. crystals, 1s. 0¾d. per lb.; less 5%, ex store.

COPPER SULPHATE.—£18 5s. per ton, less 2% in casks. MANCHESTER: £18 10s. per ton f.o.b. SCOTLAND: £19 per ton, less 5%, Liverpool, in casks.

CREAM OF TARTAR.—100%, 92s. per cwt., less 2½%. GLASGOW: 99%, £4 12s. per cwt. in 5-cwt. casks.

FORMALDEHYDE.—£20-£22 per ton.

FORMIC ACID.—85%, in carboys, ton lots, £42 to £47 per ton.

GLYCERINE.—Chemically pure, double distilled, 1.260 s.g., in tins, £3 17s. 6d. to £4 17s. 6d. per cwt. according to quantity; in drums, £3 10s. 0d. to £4 2s. 6d.

HYDROCHLORIC ACID.—Spot, 5s. 6d. to 8s. carboy d/d according to purity, strength and locality.

IODINE.—Resublimed B.P., 6s. 9d. per lb. in 7 lb. lots.

LACTIC ACID.—(Not less than ton lots). Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £50; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £55; edible, 50%, by vol., £41. One-ton lots ex works, barrels free.

LEAD ACETATE.—LONDON: White, £31 10s. ton lots; brown, £35. GLASGOW: White crystals, £30; brown, £1 per ton less. MANCHESTER: White, £31; brown, £30.

LEAD, NITRATE.—£32 per ton for 1-ton lots.

LEAD, RED.—£31 15s. 0d. 10 cwt. to 1 ton, less 2½% carriage paid. SCOTLAND: £31 per ton, less 2¼% carriage paid for 2-ton lots.

LITHARGE.—SCOTLAND: Ground, £31 per ton, less 2½%, carriage paid for 2-ton lots.

MAGNESITE.—Calcined, in bags, ex works, about £8 per ton. SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—Solid (ex wharf) £5 10s. per ton. SCOTLAND: £7 5s. per ton.

MAGNESIUM SULPHATE.—Commercial, £5 10s. per ton, ex wharf.

MERCURY.—Ammoniated B.P. (white precip.), lump, 5s. 10d. pe. lb.; powder B.P., 6s. 0d.; bichloride B.P. (corros. sub.) 5s. 1d.; powder B.P. 4s. 9d.; chloride B.P. (calomel), 5s. 10d.; red oxide cryst. (red precip.), 6s. 11d.; levig. 6s. 5d.; yellow oxide B.P. 6s. 3d.; persulphate white B.P.C., 6s. 0d.; sulphide black (hyd. sulph. cum sulph. 50%), 5s. 11d. For quantities under 112 lb., 1d. extra; under 28 lb., 5d. extra.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

NITRIC ACID.—Spot, £25 to £30 per ton according to strength, quantity and destination.

OXALIC ACID.—£48 15s. to £57 10s. per ton, according to packages and position. GLASGOW: £2 9s. per cwt. in casks. MANCHESTER: £49 to £55 per ton ex store.

PARAFFIN WAX.—SCOTLAND: 3¾d. per lb.

POTASH CAUSTIC.—Solid, £35 5s to £40 per ton according to quantity, ex store; broken, £42 per ton. MANCHESTER: £39.

POTASSIUM CHLORATE.—£36 7s. 6d. per ton. GLASGOW: 4¼d. per lb. MANCHESTER: £37 per ton.

POTASSIUM DICHROMATE.—5¼d. per lb. carriage paid. SCOTLAND: 5¼d. per lb., net, carriage paid.

POTASSIUM IODIDE.—B.P. 6s. 3d. per lb. in 7 lb. lots.

POTASSIUM NITRATE.—Small granular crystals, £24 to £27 per ton ex store, according to quantity. GLASGOW: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 9¼d. to 10½d. per lb. SCOTLAND: B.P. Crystals, 10½d. MANCHESTER: B.P. 10½d. to 11½d.

POTASSIUM PRUSSIATE.—6½d. per lb. SCOTLAND: 6¾d. net, in casks, ex store. MANCHESTER: Yellow, 6¼d. to 6½d.

PRUSSIATE OF POTASH CRYSTALS.—In casks, 6¾d. per lb. net, ex store

SALAMMONIAC.—Firsts lump, spot, £42 17s. 6d. per ton, d/d address in barrels. Dog-tooth crystals, £36 per ton; fine white crystals, £18 per ton, in casks, ex store. GLASGOW: Large crystals, in casks, £37 10s.

SALT CAKE.—Unground, spot, £3 11s. per ton.

SODA ASH.—58% spot, £5 17s. 6d. per ton f.o.r. in bags.

Soda, Caustic.—Solid, 76/77° spot, 13s. 10s. per ton d/d station. Scotland: Powdered 98/99%, £18 10s. in drums, £19 5s. in casks, Solid 76/77° £15 12s. 6d. in drums; 70/73%, £15 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts, 10s. per ton less.

Soda Crystals.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

Sodium Acetate.—£19-£20 per ton carriage paid North. Glasgow: £18 10s. per ton net ex store.

Sodium Bicarbonate.—Refined spot, £10 15s. per ton d/d station in bags. Glasgow: £13 5s. per ton in 1 cwt. kegs, £11 5s. per ton in 2-cwt. bags. Manchester: £10 15s.

Sodium Bisulphite Powder.—60/62%, £14 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£20 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£27 10s. to £32 per ton. Glasgow: £1 11s. per cwt., minimum 3 cwt. lots.

Sodium Dichromate.—Crystals cake and powder 4¼d. per lb. net d/d U.K. with rebates for contracts.

Sodium Chromate.—4¼d. per lb. d/d U.K.
4d. per lb. Glasgow: 4¼d. net, carriage paid.

Sodium Hyposulphite.—Pea crystals, £15 5s. per ton for 2-ton lots; commercial, £11 5s. per ton. Manchester: Commercial, £11; photographic, £15 10s.

Sodium Metasilicate.—£14 5s. per ton, d/d U.K. in cwt. bags.

Sodium Nitrate.—Refined, £8 per ton for 6-ton lots d/d. Glasgow: £1 12s. 0d. per cwt. in 1-cwt. kegs, net, ex store.

Sodium Nitrite.—£18 5s. per ton for ton lots.

Sodium Perborate.—10%, 9½d. per lb. d/d in 1-cwt. drums.

Sodium Phosphate.—Di-sodium, £12 per ton delivered for ton lots. Tri-sodium, £16 10s. per ton delivered per ton lots.

Sodium Prussiate.—½d. per lb. for ton lots. Glasgow: 5d. to 5¾d. ex store. Manchester: 4¼d. to 5¼d.

Sodium Silicate.—£8 2s. 6d. per ton.

Sodium Sulphate (Glauber Salts).—£3 per ton d/d.

Sodium Sulphate (Salt Cake).—Unground spot, £3 to £3 10s. per ton d/d station in bulk. Scotland: Ground quality, £3 5s. per ton d/d. Manchester: £3 12s. 6d.

Sodium Sulphide.—Solid 60/62%, Spot, £11 15s. per ton d/d in drums; crystals, 30/32%, £9 per ton d/d in casks. Manchester: Concentrated solid, 60/62%, £11; commercial, £8 10s.

Sodium Sulphite.—Pea crystals, spot, £14 10s. per ton d/d station in kegs.

Sulphur Precip.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.

Sulphuric Acid.—168° Tw., £4 11s. to £5 1s. per ton; 140° Tw., arsenic-free, £3 to £3 10s.; 140° Tw., arsenious, £2 10s.

Tartaric Acid.—1s. 1¼d. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. Manchester: 1s. 1¼d. per lb. Glasgow: 1s. 1¼d. per lb., 5%, ex store.

Zinc Sulphate.—Tech., £11 10s. f.o.r., in 2 cwt. bags.

Rubber Chemicals

Antimony Sulphide.—Golden, 7d. to 1s. 2d. per lb., according to quality. Crimson, 1s. 6d. to 1s. 7½d. per lb.

Arsenic Sulphide.—Yellow, 1s. 5d. to 1s. 7d. per lb.

Barytes.—£6 to £6 10s. per ton, according to quality.

Cadmium Sulphide.—3s. 9d. to 4s. per lb.

Carbon Black.—3½d. to 3 15/16d. per lb., ex store.

Carbon Disulphide.—£31 to £33 per ton, according to quantity, drums extra.

Carbon Tetrachloride.—£41 to £46 per ton, according to quantity, drums extra.

Chromium Oxide.—Green, 10½d. to 11d. per lb.

Diphenylguanidine.—2s. 2d. per lb.

India-rubber Substitutes.—White, 4¾d. to 5¼d. per lb.; dark 3¾d. to 4¼d. per lb.

Lamp Black.—£24 to £26 per ton del., according to quantity. Vegetable black, £35 per ton upwards.

Lead Hyposulphite.—9d. per lb.

Lithopone.—Spot, 30%, £16 10s. per ton, 2-ton lots d/d in bags.

Sulphur.—£9 to £9 5s. per ton. Sulphur precip. B.P., £55 to £60 per ton. Sulphur precip. comm., £50 to £55 per ton.

Sulphur Chloride.—5d. to 7d. per lb., according to quantity.

Vermilion.—Pale, or deep, 4s. 9d. per lb., 1-cwt. lots.

Zinc Sulphide.—£58 to £60 per ton in casks ex store, smaller quantities up to 1s. per lb.

Nitrogen Fertilisers

Ammonium Sulphate.—The following prices have been announced for neutral quality basis 20.6% nitrogen, in 6-ton lots delivered farmer's nearest station up to June 30, 1938: November, £7 8s.; December, £7 9s. 6d.; January, 1938, £7 11s.; February, £7 12s. 6d.; March/June, £7 14s.

Calcium Cyanamide.—The following prices are for delivery in 5-ton lots, carriage paid to any railway station in Great Britain up to June 30, 1938: November, £7 10s.; December, £7 11s. 3d.; January, 1938, £7 12s. 6d.; February, £7 13s. 9d.; March, £7 15s.; April/June, £7 16s. 3d.

Nitro Chalk.—£7 10s. 6d. per ton up to June 30, 1938.

Sodium Nitrate.—£8 per ton for delivery up to June 30, 1938.

Concentrated Complete Fertilisers.—£11 4s. to £11 13s. per ton in 6-ton lots to farmer's nearest station.

Ammonium Phosphate Fertilisers.—£10 19s. 6d. to £14 16s. 6d. per ton in 6-ton lots to farmer's nearest station.

Coal Tar Products

Benzol.—At works, crude, 9½d. to 10d. per gal.; standard motor, 1s. 3½d. to 1s. 4d., 90%, 1s. 4½d. to 1s. 5d., pure, 1s. 8½d. to 1s. 9d. Glasgow: Crude, 10d. to 10½d. per gal.; motor, 1s. 4d. to 1s. 4½d. Manchester: Pure, 1s. 8d. per gal.; crude, 1s. per gal.

Carbolic Acid.—Crystals, 7½d. to 8½d. per lb., small quantities would be dearer; Crude, 60's, 1s. 9d. to 2s. 0d.; dehydrated, 2s. 6d. per gal., according to specification; Pale, 99/100%, per lb. f.o.b. in drums; crude, 2s. 1d. per gal.

Creosote.—Home trade, 4½d. per gal., f.o.r. makers' works; exports 6¾d. to 6¾d. per gal., according to grade. Manchester: 4d. to 5d. Glasgow: B.S.I. Specification, 6d. to 6½d. per gal.; washed oil, 5d. to 5½d.; lower sp. gr. oils 5¾d. to 6¼d.

Cresylic Acid.—97/99%, 1s. 9d. to 2s.; 99/100%, 2s. 6d. to 3s. 6d. per gal., according to specification; Pale, 99/100%, 2s. 1d. to 2s. 3d.; Dark, 95%, 1s. 7d. to 1s. 8d. per gal. Glasgow: Pale, 99/100%, 5s. to 5s. 6d. per gal.; pale, 97/99%, 4s. 6d. to 4s. 10d., dark, 97/99%, 4s. 3d. to 4s. 6d.; high boiling acids, 2s. to 2s. 6d. American specification, 3s. 9d. to 4s. Manchester: Pale, 99/100%, 2s.

Naphtha.—Solvent, 90/160, 1s. 6d. to 1s. 7d. per gal.; solvent, 95/160%, 1s. 7d. to 1s. 8d., naked at works; heavy 90/190%, 1s. 1d. to 1s. 3d. per gal., naked at works, according to quantity. Glasgow: Crude, 6½d. to 7¼d. per gal.; 90%, 160, 1s. 5d. to 1s. 6d., 90%, 190, 1s. 1d. to 1s. 3d.

Naphthalene.—Crude, whizzed or hot pressed, £5 to £6 per ton; purified crystals, £11 per ton in 2-cwt. bags. London: Fire lighter quality, £3 to £4 10s. per ton. Glasgow: Fire lighter, crude, £6 to £7 per ton (bags free). Manchester: Refined, £12 10s. to £13 10s. per ton f.o.b.

Pitch.—Medium, soft, 33s. per ton, f.o.b. Manchester: 31s. 6d. f.o.b., East Coast. Glasgow: f.o.b. Glasgow, 35s. to 37s. per ton; in bulk for home trade, 35s.

Pyridine.—90/140%, 11s. 6d. to 13s. 6d. per gal.; 90/160%, 9s. 6d. to 10s. 9d. per gal.; 90/180%, 2s. 6d. to 3s. 6d. per gal. f.o.b. Glasgow: 90% 140, 10s. to 12s. per gal.; 90% 160, 9s. to 10s.; 90% 180, 2s. 6d. to 3s. Manchester: 9s. 6d. to 11s. 6d. per gallon.

Toluol.—90%, 1s. 10d. per gal.; pure 2s. 2d. Glasgow: 90% 120, 1s. 10d. to 2s. 1d. per gal. Manchester: Pure 2s. 4d. per gallon, naked.

Xylol.—Commercial, 1s. 11d. to 2s. per gal.; pure, 2s. 3d. to 2s. 3½d. Glasgow: Commercial, 2s. to 2s. 1d. per gal.

Wood Distillation Products

Calcium Acetate.—Brown, £6 15s. to £9 5s. per ton; grey, £8 15s. to £9 5s. Manchester: Brown, £8 10s.; grey, £9 15s.

Methyl Acetone.—40.50%, £36 to £38 per ton.

Wood Creosote.—Unrefined, 4d. to 6d. per gal., according to boiling range.

Wood Naphtha, Miscible.—2s. 8d. to 3s. per gal.; solvent, 3s. 3d. to 3s. 6d. per gal.

Wood Tar.—£2 to £8 per ton, according to quality.

Intermediates and Dyes

Aniline Oil.—Spot, 8d. per lb., drums extra, d/d buyer's works.

Aniline Salts.—Spot, 8d. per lb. d/d buyer's works, casks free.

Benzidine, HCl.—2s. 7½d. per lb., 100% as base, in casks.

Benzoic Acid, 1914 B.P. (ex toluol).—1s. 11½d. per lb. d/d buyer's works.

m-**Cresol 98/100%.**—1s. 8d. to 1s. 9d. per lb. in ton lots.

o-**Cresol 30/31° C.**—6½d. to 7½d. per lb. in 1-ton lots.

p-**Cresol, 34-5° C.**—1s. 7d. to 1s. 8d. per lb. in ton lots.

Dichloraniline.—2s. 1½d. to 2s. 5½d. per lb.

Dimethylaniline.—Spot, 1s. 7½d. per lb., package extra.

Dinitrobenzene.—8d. per lb.

Dinitrochlorbenzene, Solid.—£79 5s. per ton.

Dinitrotoluene.—48/50° C., 9½d. per lb.; 66/68° C., 11d.

Diphenylamine.—Spot, 2s. 2d. per lb., d/d buyer's works.

Gamma Acid, Spot, 4s. 4½d. per lb. 100% d/d buyer's works.

H Acid.—Spot, 2s. 7d. per lb.; 100% d/d buyer's works.

Naphthionic Acid.—1s. 10d. per lb.

β-**Naphthol** —£97 per ton; flake, £94 8s. per ton.

α-**Naphthylamine.**—Lumps, 1s. 1d. per lb.

β-**Naphthylamine.**—Spot, 3s. per lb.; d/d buyer's works.

Neville and Winther's Acid.—Spot, 3s. 3½d. per lb. 100%.

o-**Nitraniline.**—4s. 3½d per lb.

m-**Nitraniline.**—Spot, 2s. 10d. per lb. d/d buyer's works.

p-**Nitraniline.**—Spot, 1s. 10d. to 2s. 3½d. per lb. d/d buyer's works.

Nitrobenzene.—Spot, 4½d. to 4¾d. per lb., in 90-gal. drums, drums extra. 1-ton lots d/d buyer's works.

Nitronaphthalene.—10½d. per lb.; P.G., 1s. 0½d. per lb.

Sodium Naphthionate.—Spot, 1s. 11d. per lb.; 100% d/d buyer's works.

Sulphanilic Acid.—Spot, 8¾d. per lb. 100%, d/d buyer's works.

o-**Toluidine.**—11d. per lb., in 8/10 cwt. drums, drums extra.

p-**Toluidine.**—1s. 11d. per lb., in casks.

m-**Xylidine Acetate.**—4s. 8d. per lb., 100%.

Commercial Intelligence

Mortgages and Charges

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BLOOMDALE CHINA CLAY CO., LTD., London, E.C. (M.C., 8/10/38.) Sept. 22, £1,000 debenture, to Wengers, Ltd.; general charge. *——. Jan. 4, 1938.

BRITANNIA LEAD CO., LTD., London, E.C. (M.C., 8/10/38.) Sept. 26, letter of credit securing all moneys due or to become due from the company to Hambros Bank, Ltd., and/or Erlangers, Ltd., not ex. £400,000; charged on certain silver lead bullion, ranking in priority to debenture dated April 19, 1932. * $1,000,000 and letter of credit not to exceed £400,000. Oct. 29, 1937.

WILLIAM BEARDMORE AND CO., LTD., London, S.W., steel manufacturers. (M.C., 8/10/38.) Sept. 22. Trust Deed dated Sept. 21, 1938, securing £600,000 1st debenture stock, present issue £579,562; general charge. * £1,186,125. July 1, 1938.

Satisfactions

BRITANNIA LEAD CO., LTD., London, E.C. (M.S., 8/10/38.) Satisfaction Sept. 26, of letter of credit registered Sept. 20, 1937.

FERRAMIC INDUSTRIES, LTD., Welwyn Garden City, manufacturers of chemical preparations. (M.S., 8/10/38.) Satisfaction Sept. 24, of mortgage registered Jan. 13, 1938.

Declarations of Solvency Filed

PHENSIC, LTD., Manchester, manufacturers of medicines, etc. (D.S.F., 8/10/38.) Sept. 22.

Company News

Attock Oil Co., Ltd., have passed extraordinary resolutions increasing the capital of the company to £1,800,001 by the creation of an additional 300,000 ordinary shares of £1 each.

British Xylonite Co., Ltd., announce that they have decided not to make any interim distribution. Further consideration of a dividend will be made at the end of the year. At this time last year an interim of 2½ per cent. was paid, followed by a final distribution of 7½ per cent.

Forthcoming Events

London.

October 5-15.—Inventions Exhibition.

October 10.—Institution of the Rubber Industry (London and District Section), Northumberland Rooms, Northumberland Avenue, W.C.2. 7.30 p.m. Dr. C. F. Flint, "Compounding Ingredients for Latex."

October 11.—Institution of Chemical Engineers. Joint meeting with the Incorporated Association of Rating and Valuation Officers. Burlington House, Piccadilly, W.1. 6 p.m. P. Michael Faraday, "Principles and Practice of Rating of Industrial Concerns, with Special Reference to Chemical Works."

October 13.—Institute of Fuel. Institution of Mechanical Engineers. Storey's Gate, S.W.1. 3.30 p.m. Professor R. V. Wheeler, The Melchett Lecture.

Association of British Chemical Manufacturers, annual dinner. Grosvenor House, Park Lane. 7.30 p.m.

Oil and Colour Chemists' Association (London Section), H. K. Whalley, "Spectrographic Analysis."

October 14.—Institute of Chemistry. 30 Russell Square, W.C.1, 8 p.m. Professor F. M. Rowe, "The Development of the Chemistry of Dyestuffs."

Society of Chemical Industry. Joint meeting with the Groups. Cinematograph film of the annual meeting of the Society, 1938, in Canada.

October 17-21.—Medical Exhibition.

Bristol.

October 13.—Society of Chemical Industry. The University, Woodland Road. 7.30 p.m. Professor W. N. Haworth, "The Structure of Cellulose and Other Polymers related to Simple Sugars."

Hull.

October 18.—Hull Chemical and Engineering Society. Municipal Technical College, Park Street. 7.45 p.m. K. MacLennan, "The Utilisation of Cod Liver Oil."

Leeds.

October 10.—Institute of Chemistry (Leeds Area Section). The University, 7 p.m. The Registrar, "From Boyle to Priestley."

Liverpool.

October 13.—The Institute of Chemistry. R. R. Butler, "A Study in Standardisation."

Manchester.

October 14.—Society of Chemical Industry. Constitutional Club, St. Ann Street. 7 p.m. Dr. W. A. Sexton, "Pest Control."

Scotland.

October 14.—Oil and Colour Chemists' Association. Professor Dr. Wolfgang Ostwald, "Swelling and Solubility of High Molecular Weight Materials in Organic Solvents."

Stoke-on-Trent.

October 10.—British Ceramic Society (Pottery Section). North Staffordshire Technical College. 7.30 p.m. T. Simpson and Dr. H. W. Webb, "Silica in Earthenware Bodies."

Chemical and Allied Stocks and Shares

ALL sections of the Stock Exchange showed rapid response to the removal of war fears and in many cases share values have moved to higher levels than those ruling prior to the recent crisis in international affairs. At the time of writing earlier gains have not been fully held, largely because of uncertainty whether there is to be a General Election during the next few months. Nevertheless, it is generally agreed that the removal of the extreme tension in international affairs and the better relations between the big European powers are bound to give a stimulus to business enterprise.

Shares of companies associated with the chemical and kindred industries moved closely with the day-to-day trend of the Stock Exchange and in nearly all cases have risen strongly in price as compared with a week ago. British Oxygen, for instance, are 71s. 3d. at the time of writing, compared with 63s. 9d. last week, while large gains have also been recorded by Turner and Newall, now 76s. 10½d., and also by Murex, which have recovered to 77s. 6d. Associated Cement are 78s. 9d., compared with 72s. 6d. a week ago, and other cement shares also improved strongly in price. British Plaster Board have moved up to 26s. 9d. General Refractories are slightly better at 10s. 3d., despite the recent announcement that the directors have decided not to pay an intrim dividend. Imperial Chemicals are 30s. 7½d. at the time of writing.

British Match rallied to 34s., and Swedish Match to 26s. 9d., while Lever and Unilever have risen strongly to 36s. 3d., and other shares with an international market are well above the low levels touched last week when war fears persisted. International Nickel and most of the more prominent dollar shares have moved to higher prices, partly because of indications that the improvement of industrial conditions in the United States is making steady progress.

Boots Pure Drug recovered strongly to 41s. 6d., while Sangers are 22s. 3d., and Timothy Whites and Taylors are higher at 25s. Beechams Pills deferred shares attracted attention at the higher price of 9s., owing to the announcement that the company is to make an offer for the ordinary shares of Eno Proprietaries.

Distillers at 93s. show a very large recovery, although the best price touched during the past few days has not been maintained. Triplex Glass were considerably higher at 31s. 3d., and good improvement was shown by United Glass Bottle ordinary shares. Fison, Packard and Prentice were firm at 34s., awaiting the forthcoming results. Burt, Boulton and Haywood ordinary were maintained at 18s. 9d., following the dividend announcement. B. Laporte have improved from 83s. 9d. to 85s.; declaration of the interim dividend is due next month. Monsanto Chemicals preference shares were again quoted around 22s., and Greeff-Chemicals Holdings 5s. ordinary units at around 6s. 3d. Imperial Smelting were better at 7s. 9d. Results of the latter company fall to be issued next month, but no dividend can, of course, be expected on the ordinary shares in view of the announcement, made earlier in the year, that the dividend on the preference shares would not be paid in full.

Dorman Long and other leading iron, steel and allied shares have reflected the upward trend in the stock and share markets. United Steel have risen to 24s. 3d., aided by the excellent impression created by the full report, which shows that earnings on the ordinary capital are well in excess of the 10 per cent. dividend. Stewarts and Lloyds improved, as did Tube Investments.

Anglo-Iranian and other oil shares have responded strongly to the better trend of markets. Burmah Oil were firmer under the influence of the maintenance of the interim dividend on the larger capital arising from the share bonus distributed earlier in the year.